MultiMux

MMH900 Series Statistical Multiplexer

Owner's Manual

MultiTech®
Systems

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protections against harmful interference when the equipment is operated in a commercial installation. This equipment generates, uses and can radiate radio frequency energy, and if not isntalled and used in accoradance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Warning: *Changes or modifications to this unit not expressly approved by the party responsible for ocmpliance could void the user's authority to operate the equipment.*

The CE mark is affixed to the enclosed MuliTech product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility;

and

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certian voltage limits;

both amended by

Council directive 93/68/EEC of 22 July 1993 on the harmonization of CE marking requirements.

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82021308 Revision L

MultiMux (#MMH904Ca) (#MMH908Ca)

Record of Revisions

Revision	Description
J (09/09/96)	Manual revised to include the ISDN terminal adapter. All pages at Revision J.
K (06/30/97)	Manual Revised to include CE Mark. All pages at Revision K.
L (11/17/97)	Manual revised to incorporate minor editorial comments. All pages at revision L.

TRADEMARK

Trademark of Multi-Tech Systems, Inc. are as follows: MultiMux, MultiModem and the Multi-Tech logo.

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MultiMux

Chapter 1 - Introduction & Description

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1.1   Introduction

Congratulations! Your new MultiMux MMH900 series is one of the finest statistical multiplexers on the market today. The MultiMux is completely software driven and is controlled by you through its command port. This gives you great flexibility and ease of operation. This Owner's Manual will help you to install and use your MultiMux, and also provide you with a valuable information resource in the future.
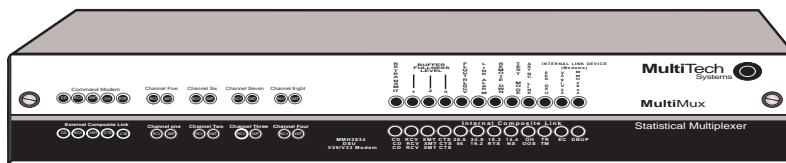
Figure 1-1. MultiMux MMH900 Series

1.2   About This Manual

This manual is comprised of eight chapters. There are also several appendices at the end of the manual, most of which is a condensed version of the information contained in the chapters. These appendices can be used as a quick reference.   The information contained in each chapter is as follows:

Chapter 1 - Introduction

This chapter is an introduction to the world of multiplexing. Since you have already acquired the MultiMux, you may have an extensive background in multiplexing. In which case, this introduction will provide a good review.

Chapter 2 - Configuration

This chapter defines the configurations of the MMH900 series and provides some typical examples of how the MultiMux is configured. The MMH900 series is available in two models; the four and eight channel units with an internal command modem, various composite link modems supporting synchronous or asynchronous communications. The typical examples explain how the MultiMux can be used in various environments.

Chapter 3 - Front and Rear Panel Descriptions

Chapter 3 describes the front panel indicators, the switches and jumpers within the cabinet and the rear panel connections. The front panel indicators are described in the various groups depending on the configuration of the MultiMux. Indicator groups are active depending on how the MultiMux is used. The front panel is the same for all models and contains some indicators for future enhancements. The back panel provides all the cable connections for the early released models with the addition of cable connections for future releases.

Chapter 4 - Installation

Chapter 4 provides the procedures for unpacking, installing and cabling your MultiMux. After your MultiMux is cabled, an initial power on procedure is provided for you to display and modify the channel and link parameters to fit your configuration.

Chapter 5 - Commands

The MultiMux is software-driven and controlled through its command port and the supervisory console. This chapter describes the AT commands and the impact each has on your system's operation.

Chapter 6 - Operating Procedures

Chapter 6 provides the operational information for your MultiMux. The MultiMux operating procedures address the channel and composite link parameters. The command modem operating procedures address the command modem access, dialing, and remote access procedures.

Chapter 7 - Troubleshooting Procedures

This chapter is a guide to troubleshooting your MultiMux. It contains a listing of error conditions, probable causes and suggested fixes or steps designed to isolate the failing unit in your communications network.

Chapter 8- Service, Warranty and Tech Support

Chapter 8 provides instructions on getting service for the MultiMux at the factory, a statement of the limited warranty, information about our user bulletin board service, and space for recording information about your multiplexer prior to calling Multi-Tech's Technical Support.

1.3 Background

Any data communications environment that has more than one asynchronous line going between common locations can probably benefit by installing a pair of statistical multiplexers (stat muxes). A stat mux performs the function of combining several asynchronous data communication channels into one composite signal that can be transmitted between two locations more inexpensively than the cost of the individual lines.

Figure 1-2 shows a simple communications network. Individual users connect to asynchronous channels and the composite (or aggregate) communications line between the two locations is the "link". Link protocol is the communications discipline used between the two multiplexers and typically operates at a speed higher than the individual asynchronous units connected to each multiplexer.
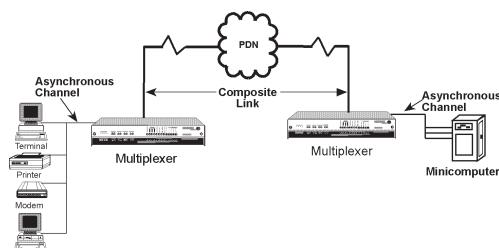
Figure 1-2. Simple Communications Network

One reason that a stat mux works is that typically an asynchronous terminal device is not used to its capacity. Studies show that as little as 10 to 15% utilization of such lines is a common occurrence. These percentages indicate that the most efficient combination of lines in a muxed asynchronous environment is between four and eight lines.

Although the primary reason for installing a mux is to save on communications costs, two other benefits are also present. One is the inherent error correction existing in muxed data and the other is data security. Since a mux functions by taking individual asynchronous data and transmitting it as data packets, there is an error detection and retransmission scheme built in. Error correction is so vital in many transmission types, such as graphic data and program transmission, that many muxes are used mainly for their error correction capabilities.

The other benefit is data security which is achieved by the fact that the individual data streams are encrypted into a single communication line on one end of the link and then broken up into individual components on the other end. Someone wishing to "tap" into a muxed signal must not only have the link protocol which is typically a proprietary version of High Level Data Link Control (HDLC), but must also know the individual channel assignment schemes and data formats.

1.3.1   Description of Statistical Multiplexing

A statistical multiplexer (also known as a stat mux) is a device that allows several other devices (usually computer terminals or PCs) to communicate over a single transmission line. Sometimes called concentrators, they take data from different devices and combine it into a single stream that can be transmitted, via a modem, to an identical multiplexer at another location, where the stream is then separated back into its original form. Physically, a mux looks like a box with a bunch of serial ports and some LEDs. The most typical task of the MultiMux is to connect a group of PCs or terminals at one site to a mini or mainframe computer at another site via a single set of modems rather than using individual modems for each PC or terminal.

1.3.1.1 Statistical Multiplexing

Statistical multiplexing is sometimes referred to as statistical time-division multiplexing (STDM). The use of the voice-grade phone line (or any other communications link) is based not on peak data rates, but on effective (or average) data rates.

During the peaks, when the sum of the data rates of the channels being served exceeds the data rate of the composite link, a statistical multiplexer saves the excess data in buffers (in effect, allowing individual channel buffers to expand). The buffers are emptied as soon as the activity falls off. The proper allocation of buffer space, plus the implementation of "flow control" and "pacing" techniques to accommodate unusually high peaks, allows the use of composite link speeds that are less than the sum of the individual channel speeds.

In effect, a statistical multiplexer services only active channels. However, the efficiency thus realized is not the only benefit of the technique. Because composite link activity need not be synchronized with the activity on the individual channels, there is considerable flexibility in the choice of the composite channel protocol and speed. The use of a synchronous protocol like HDLC provides for error detection and retransmission over the composite link. Thus, asynchronous terminals, which have no inherent error-recovery capability, can enjoy end-to-end data integrity.

1.3.1.2 Communications

The basic functions of multiplexing are to make communications more efficient, to provide a means of improving accuracy of asynchronous communications by using synchronous techniques, and to improve data security by encrypting several data streams into one coded link.

The channel devices can be any asynchronous RS232 compatible units, from "dumb terminals" to personal computers running asynchronous communications software. The connection between the channel devices and the MultiMux is made through an RS232 interface cable. Asynchronous modems (long haul or short haul), asynchronous modem emulators and asynchronous line drivers (DCE devices) can be used in this connection (up to 38.4K bps) to extend the distance between the channel devices and the MultiMux.

The connection between the two MultiMuxes is the composite link, and can be up to 128K bps. Using an internal modem, ISDN terminal adapter, DSU, or external device, the MultiMux can be connected to different types of communications links, such as a dial-up line, leased line, Basic Rate Interface (BRI) ISDN service, or a DDS network. If an external link device is used the MultiMux can communicate with it using either the RS232 or V.35 standard.

1.4   Product Description

There are two basic models of MultiMux MMH900 series available: a four channel and eight channel units with internal command modem, optional composite link modems and a command port. The four channel MultiMux MMH904 connects four async devices to asynchronous channels that transfer data at a channel speed of up to 38.4K bits per second (bps). The eight channel MultiMux MMH908 connects eight async devices. The composite link of the MultiMux MMH900 series can be configured for various dial-up and lease line modems, a Digital Service Unit (DSU) for digital communications over a Digital Data Service (DDS) or dedicated network, or an ISDN terminal adapter for Basic Rate Interface Service. The command port allows you to configure the MultiMux MMH900 series for your channel configuration, internal hardware and composite link configuration.

A simplified block diagram of a MultiMux network is shown in Figure 1-3 to give you a pictorial view of a complete network. The MultiMux represented in the figure is a MultiMux MMH904 connected to four async devices on CHANNEL 1 through CHANNEL 4. The workstation connected to the COMMAND PORT is the supervisory console in which you can communicate with the command processor or command modem. If a remote connection is needed to the command modem, a separate DIAL-UP connection is provided. The composite link can be configured for an internal 28.8K bps dial-up/leased line modem, internal DSU for digital communications over a digital data service (DDS) network or an ISDN terminal adapter for Basic Rate Interface Service. It can also be configured for external synchronous link device with either V.24 or V.35 interface.
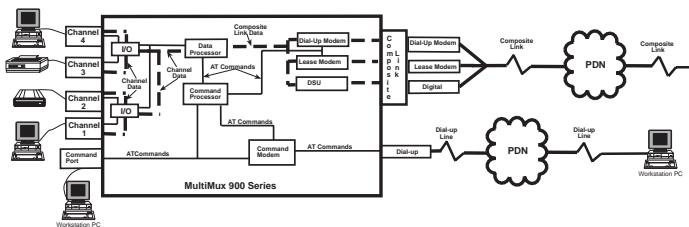
Figure 1-3. MultiMux MMH900 Series Block Diagram

To setup a MultiMux MMH900 series, the async devices have to be connected to the channels, the composite link connected to the public data network (PDN) and the MultiMux has to be configured for the channel devices and the composite link. The async devices are connected to CHANNEL 1 through CHANNEL 4 connectors on the back panel of the MultiMux MMH904 with an RS232 cable. The MultiMux MMH908 has four additional channel connectors for connecting up to eight devices.

A number of internal and external composite link devices can be used to connect the MultiMux to the PDN. The MMH900 series has an internal 28,800 bps composite link modem or an internal 56,000 bps DSU. The modem is connected to the PDN through the INTERNAL COMPOSITE LINK LEASED MODEM connector on the back panel of the MultiMux. The internal DSU is connected to a DDS or dedicated network through the COMPOSITE LINK DIGITAL DSU connector on the back panel. The supervisory console is connected to the MultiMux through the COMMAND PORT connector on the back panel. The supervisory console connection is also an RS232 connection. This completes a typical hardware setup for a MultiMux. Now the MultiMux has to be configured to talk to the channel devices and communicate over the composite link.

Configuration of a MultiMux is accomplished through a combination of setting DIP switches behind the front panel and software commands entered through the supervisory console. The DIP switches determine whether the MultiMux is a four or eight channel multiplexer, whether the composite link device is an internal modem or DSU or an external device, whether or not the command modem will accept remote access, etc. The DIP switches control the hardware setup and the operating setup is controlled through software commands. The software commands are entered at a terminal connected to the COMMAND PORT which are transferred to either the command processor or command modem in the MultiMux. The software commands are AT commands that configure the channel devices to communicate with the MultiMux and configure the composite link device to communicate with the PDN. To configure a channel device, the correct channel speed has to be established, number of data and stop bits in a word determined, the type of flow control and whether or not it is used and whether or not pacing is active. These are just some of the AT commands that are used to configure and display the status of the channel devices.

When the MultiMux MMH900 series is powered up, the command processor transfers the stored configuration of the channel devices to the data processor. The data processor takes the configuration information and configures each channel for its particular conditions. The composite link has to be configured for its parameters before data can be transferred.

The composite link parameters are determined by more than just AT commands transferred to the command processor. The composite link parameters are determined by what type of device is used, whether it is internal or external, speed, what type of remote multiplexer we are communicating with and a number of line conditioning parameters. The type of device used as the composite link device is determined by whether the device is internal or external which is established by a DIP switch setting and by the type of device installed in the MultiMux or connected to the EXTERNAL COMPOSITE LINK RS232C/V.35 connector on the back panel. If an internal composite link MMH2834 modem is installed, the DIP switch would be set for an internal composite link device. The type of MultiMux at the other end of the composite link is determined by the setting of a four position DIP switch within the MultiMux. The MultiMux MMH900 series is now ready to transfer data from its async devices through an internal composite link modem.

1.5   System Features

1.5.1   Response Time Control

Response time control is the technique used by a mux to make sure that no user experiences undue delays in performance due to a specific channel using too much link time. This can occur if one of the channels is performing a high volume batch function, such as a print dump or program transfer.

There are a variety of priority control (response time) schemes in use by different mux vendors. Some vendors use a switch selection approach where each channel can be given a high, medium or low setting with the low used for those channels requiring higher volume batch transfers. There are also software-sensing response time techniques where the microprocessor actually monitors channel activity, and when a high volume is sensed, that channel is given a lower priority so it will not crowd out the others.

The MultiMux response time control method is one where data is transferred from each channel on a timed basis while limiting the amount sent with each transmission.

This insures that interactive users will not experience undue delays but, on the other hand, batch activity can still be accommodated. This, combined with a Response Time command and the ability to shut off channels not being used, gives the MultiMux a very efficient priority control system.

1.5.2   Dynamic Buffering

A basic requirement of all muxes is some sort of buffering capability to temporarily hold channel data while it is being assembled into a block. In the early days, a mux was sometimes judged by the size of its buffers. Large buffers are unnecessary in newer designs that include sophisticated dynamic buffer allocation techniques where the amount of buffer per channel is assigned on an as-needed basis.

In the MultiMux, each channel is assigned 1K of buffer, but in the case where more buffer is needed, the MultiMux will start assigning additional buffers from the channels not requiring it. In this way a single channel can have up to 8K of buffer if required. When dynamic buffering is combined with efficient flow control and the automatic transmission of data from each channel at set intervals, as in the MultiMux, very smooth operation for each user is the result.

1.5.3   Flow Control

Flow control regulates the volume of data entering the buffers. When a particular channel buffer is almost full, a flow control command is issued which stops further activity until the buffer is emptied. The most common flow control methods currently used are Xon/Xoff, RS232C signal control (using DTR or CTS) and ENQ/ACK. The MultiMux supports all three.

**MUX INITIATED
FLOW CONTROL**

Channel Device → **DATA** → Mux

Flow control stops the **input** of data to the mux

**CHANNEL DEVICE
INITIATED PACING**

Mux → **DATA** → Channel Device

Pacing stops the output of data from the mux
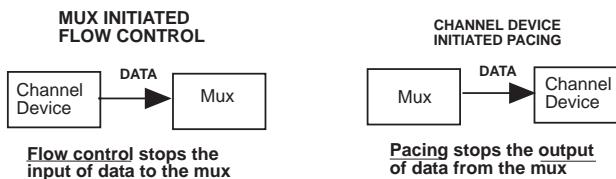
1.5.4   Diagnostics

Diagnostics in a multiplexer network are of considerable importance. When a multiplexer fails there is not just one operator down, but many. That is why the MultiMux is equipped with several diagnostic modes that will test every aspect of the network. The diagnostics include easy-to-execute tests for each channel, the composite link and for various components of the MultiMux unit itself. There are nine different test modes to ensure error free operation. They include Analog Loop, Digital Loop, Remote Analog Loop, Switch and LED tests, Non-Volatile Memory test, three other tests and a "Watchdog Timer" reset test.

1.5.5   Downline Parameter Loading

Operational parameters for both local and remote MultiMux units can be set from one location. The MMH900 series can downline load parameters to each other, but they cannot send parameters to the MM16xx/MM32xx and MMH16/MMH32 units. When power is first applied (or a Reset command is executed) to the local or remote MultiMux, operational parameters are automatically sent over the composite link to the remote MultiMux. For this function to work, the 8-position DIP switch SW1 on the local (sending) MultiMux must be set to the OPEN position and on the remote (receiving) MultiMux the 8-position DIP switch SW1 must be set to the CLOSED position.

1.5.6   Operational Statistics and Auto-Reporting

Operational statistics provides the activity report for the MultiMux network, and Auto-Reporting provides a means to report on these statistics through the supervisory console on a set periodic time cycle. Statistics such as receive-block errors pinpoint modem or line problems, and flow control time totals indicate channel devices being set at excessive speeds. Two simple commands are all that is necessary to select statistical reporting and time cycle. If your command port is also connected to a printer, the reports can provide an easy means of generating data for better network management.

1.5.7   Parameter Memory

A nonvolatile memory for storing configurations and options means that the MultiMux remains configured until you change it. Using this feature, you can configure a MultiMux, turn it off, ship it and use it without having to reconfigure it.

1.5.8   Channel Flexibility

The MultiMux permits a great deal of flexibility in configuring channel parameters. You can mix up channel options, including speed, word length, stop bits, parity, flow control, pacing methods, echoes and pass-through characters. Channel control commands let you change single channels, all channels or selected channels with a single command. By using the downline loading capability or the command modem, channels can be configured at the other end of the network.

1.5.9   Command Modem

The MultiMux can connect to a dial-up phone network through an integral 2400/1200/300 bps V.22bis-compatible modem called the "command modem". The command modem is an asynchronous modem used for remote configuration of the mux. The command modem is not to be confused with the "link modem", which is either an internal or external synchronous or external asynchronous device handling the data transfers over the composite link between two muxes.

By using the command modem, you get the equivalent of a remote Command Port console. Your MultiMux can be dialed into from a remote location for remote testing and configuration. The command modem will automatically answer incoming calls.

1.5.10   Composite Link

The composite link of the MultiMux is capable of synchronous, asynchronous and digital communications. The MultiMux can be connected to several different types of communications links through various modems and DSUs connected internally and externally. Internally the MultiMux can be configured with synchronous lease line modem at a link speed up to 28.8K bps or a Data Service Unit (DSU) at link speeds up to 56K bps. Externally the MultiMux can be configured with either a synchronous or asynchronous composite link modem or a DSU for digital communications. The external modems must have error correction and should have data compression for increased thru put and only hardware flow control.

1.6   FCC Regulations for Telephone Line Interconnection

1. This equipment complies with Part 68 of the FCC rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN). If requested, this information must be provided to the telephone company.

2. As indicated below the suitable jack (USOC connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.

3. The ringer equivalence number (REN) is used to determine the quality of devices which may be connected to the telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the REN's should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total REN's, contact the telephone company to determine the maximum REN for the calling area.

4. If this equipment causes harm to the telephone network, the telephone company will notify you in advance. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

5. The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.

6. If trouble is experienced with this equipment (the model of which is indicated below) please contact Multi-Tech Systems, Inc. at the address shown below for details of how to have repairs made. If the trouble is causing harm to the telephone network, the telephone company may request you remove the equipment from the network until the problem is resolved.

7. No repairs are to be made by you. Repairs are to be made only by Multi-Tech Systems or its licensees. Unauthorized repairs void registration and warranty.

8. This equipment cannot be used on public coin service provided by the telephone company. Connection to Party Line Service is subject to state tariffs. (Contact the state public utility commission, public service commission or corporation commission for information.)

9. If required, this equipment is hearing aid compatible.

1.7 DOC Terminal Equipment

Notice: The Canadian Department of Communications label identifies certificated equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian facility designated by the Supplier. Any repairs or alterations made by the user to this equipment; or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should insure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: *Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.*

The **Load Number** (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may consist of any combinations of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100.

The load number for the Command Modem is 8.

1.8   Specifications

1.8.1   Channels

Number of Channels	Up to four (#MMH904), or up to eight (#MMH908)
Maximum Speed	38,400 bps All Channels
Channel Speeds	All standard speeds from 150 bps to 38.4K bps
Data Format	Asynchronous: 5, 6, 7, or 8 data bits, with 1,1.5, or 2 stop bits
Parity	Odd, even, or none, fully transparent
Local Echo	On or off selectable for each channel
Flow Control	Xon/Xoff, CTS on/off, or HP ENQ/ACK selectable for each channel
Pacing	On or off selectable for each channel, DTR on/off, or Xon/Xoff
Interface	RS232C/CCITT V.24; 25-pin female D connectors

1.8.2   System Control

Local Access	Through MultiMux's RS232C "Command Port" Remote Access Through MultiMux's internal dial-up CCITT V.22bis/V.22, Bell 212A/103 (2400/1200/300 bps) command modem
Device	Any asynchronous keyboard terminal, PC in terminal mode (local access), or any standard dial-up 2400/1200/300bps V.22bis/V.22, 212A/103 modem (remote access)
Command Functions	Menu-driven/help screen approach. Commands to select channel speeds, flow control methods, listing of parameters, help screens, storing of configurations, downline loading, status reporting, echo controls, resets, pacing parity, stop bits, reponse time priorities, test modes, modem configurations, and other parameters.
Diagnostics	Memory test, Analog Loop, Digital Loop, Remote Analog Loop, Switch test, LED test, Non-Volatile RAM test, Watchdog Timer

1.8.3   Composite LInk

Data Format	Synchornous or Asynchornous
Link Speeds	Up to 128,000 bps
Link Protocol	Proprietary modified HDLC
Error Correction	16-bit CRC block check with ARQ
Interface	RS232C/CCITT V.35/V.24, or use MultiMux integral modem or DSU

1.8.4   33,600 bps Link Modem

Modulation	ITU-T V.34; AT&T V.32 terbo; ITU_T V.32bis, V.32, V.22bis, Bell 212A and 103 (North America) or B.23 and V.21 (international)
Speeds	300 bps tp 33.6K bps
Commands	Fully AT command compatible
Usage	Synchornous full duplex over unconditioned 2-wire or 4-wire leased line; ascynchornous half or full duples over 2-wire dial-up
Line Interface	RJ-11C jack for dial-up and 2-wire or 4-wire leased line; in Canada, one CA02B connector

1.8.5   56,000 bps DSU

Speed	56K, 19.2K, 9.6K, 4.8K, or 2.4K bps
Format	Synchornous DDS or compatible
Usage	Full duplex over LADS (Local Area Data Set) or two-pair non-loaded metallic wire
Line Interface	DDS interface with an RJ-48 keyed jack

1.8.6   ISDN Terminal Adapter

Description	Integral ISDN terminal adapter card
Operating Mode	ISDN Basic Rate; 1B+D or 2B+D
Synchronous Data Rates	2.4–128K bps
Clocking	Normal network clock (slaved to network receive clock); private network master (internal); external clock of DTE data
Commands	Menu system
D-Channel Switch	AT&T 5ESS®, 5E6; NT DMS-100™, BCS-32
Compatibility	Siemens Stromberg-Carlson EWSD®, National ISDN-1;NEC International Switch
Line Interface	2-wire ISDN Basic Rate 2B1Q U-interface; ANSI T1.601-1992 compliant; RJ-48 jack
B-Channel Aggregation	BONDING Protocol, Mode 1

1.8.7   Command Modem

Description	Bell 212A/103 & CCITT V.22bis/V.22 compatible asynchronous, full duplex over dial-up lines
Speeds	2400, 1200 and 0-300 bps
Line Interface	RJ11C jack for dial-up line

1.8.8   Electrical/Physical

Voltage	115 volts AC (standard). 240 volts AC (optional)
Frequency	47 to 63 Hz
Power Consumption	35 watts
Operating Temperature	0°C - 40°C
Dimensions	2 5/8" high x 15 3/4" wide x 11" deep; 6.7 cm high x 40.0 cm wide x 28 cm deep
Weight	12 pounds (26.4 kg)

MultiMux

Chapter 2 - Configuration

MultiTech® Systems

2.1   Introduction

The MultiMux MMH900 Series is available in two models; the four and eight channel units with an internal command modem, a composite link modem or DSU, dial-up capability from a remote location into the command modem and a command port for local AT command configuration information.

The configuration of the MultiMux MMH900 series is as follows:

Model	Description
MMH904Ca	Four channel unit with internal command modem
MMH908Ca	Eight channel unit with internal command modem
MMH90XCa/V.34	Internal 28800 bps composite link modem for lease line with dial back and automatic lease line restoral
MMH90XCa/56	Internal 56000 bps composite link DSU
MMH90XCa/IS	Internal ISDN terminal adapter for Basic Rate Interface Service

2.2   Configuration 1

Configuration 1 is two Multi-Tech MultiMux MMH904Ca/144 which are four channel multiplexers with internal 28.8K bps composite link modems linking sites one and two over a 4-wire analog lease line. The local site has the MMH904Ca/288 connected to a host minicomputer. The remote site has three terminals and a shared printer connected to the asynchronous channels of the remote mux. At the remote site, the three terminals are communicating with the remote mux on 38.4K bps asynchronous channels and the printer is configured for one setting above its cps rating. Configuration 1 is shown in Figure 2-1.
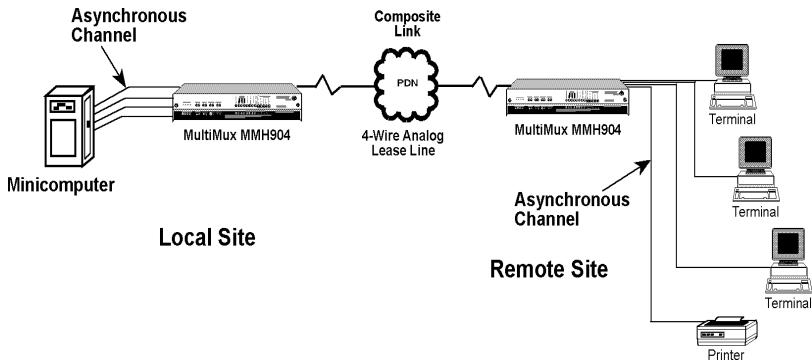
Figure 2-1. Configuration 1

Channels 1 through 4 at the local site are connected to channels 1 through 4 at the remote site. The asynchronous channels of the local mux are configured with XON/XOFF software flow control enabled, so that the channel buffers in the local mux do not lose data from the host. With flow control enabled at the local mux, the local mux can tell the host when it feels that it's dynamic buffers are becoming full. For the same reasoning, pacing should be enabled at the remote site, if it appears that data is being lost at the terminals. Pacing allows the terminal to tell the remote mux not to send any more data until its buffers are cleared. Pacing should also be active for the printer to ensure that all the data is received by the printer. The first set of parameters in the following examples are for the local mux and the second set are for the remote mux.

Local Channel Parameter

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

OK

Configuration 1 Local Site Channel Parameters

Local Channel Parameter

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF

OK

Configuration 1 Remote Site Channel Parameters

2.3 Configuration 2

Configuration 2 is two MultiMux MMH904Ca four channel multiplexers with two external Multi-Tech MultiModemII MT2834BLs linking the two sites over an async dial-up line. The MultiModemII's are connected to the dial-up line and the RS232C interface from the modems is connected to the EXTERNAL COMPOSITE LINK connector on the back panel of the MMH904Ca's. The MH904Ca's are set up for an external link device with a maximum link speed of 57,600 bps. The maximum link speed is dependent on the compressibility of the data over the link. The MultiModemIIs are set up for data compression and error correction in order to achieve the link speed.
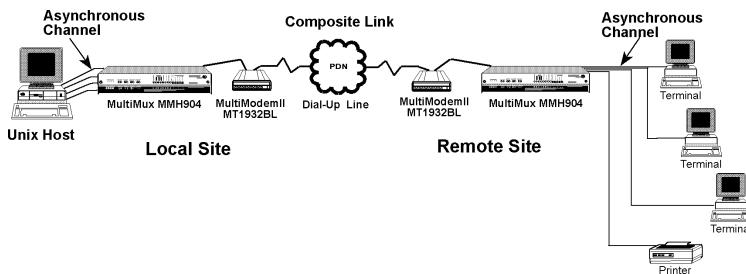
Figure 2-2. Configuration 2

The External Composite Link LEDs on the lower left side of the front panel and the SYSTEM ASYNC LINK LED in the middle of the front panel of the MMH904Ca's are active for this configuration. The channels are set up with the same considerations as in Configuration 1.The composite link configuration may be changed using the List Composite Link Configuration (**$L**) command which is shown in the following example.

LINK DEVICE	LINK FORMAT	MUX SPEED	MUX CLOCKING	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
EXTERNAL	ASYNC	57600	EXTERNAL	FF	FF	OFF

Configuration 2 Composite Link Configuration

2.4   Configuration 3

Configuration 3 is two MultiMux MMH908Ca/56 eight channel multiplexers connecting a minicomputer at the local site to eight remote terminals over a digital composite link. The MMH908Ca/56s have internal 56K bps Digital Service Units (DSUs) tieing the MultiMuxes to the Digital Data Service (DDS) network provided by your teleco facility. The DDS network is connected to the MMH908Ca/56s at the INTERNAL COMPOSITE LINK DIGITAL DSU connector on the back panel of the MultiMuxes. The composite link is set for DDS clocking.
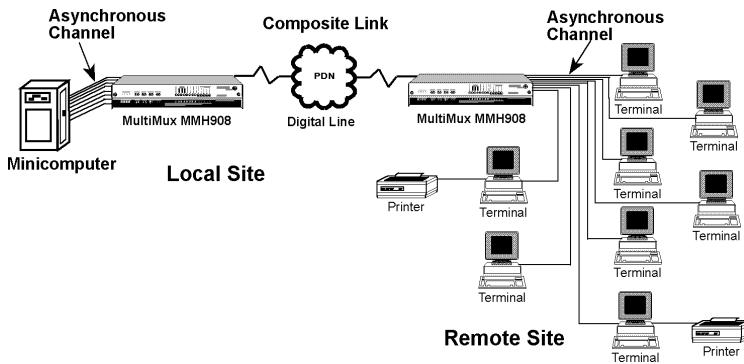
Figure 2-3. Configuration 3

The INTERNAL LINK DEVICE DSU LED in the middle of the front panel of the MMH908Ca's is lit for this configuration. The channels are set up with the same considerations as in Configuration 1. The List Composite Link Configuration (**$L**) command is shown in the following example for an internal DSU.

LINK DEVICE	LINK FORMAT	MUX SPEED	MUX CLOCKING	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
DSU	SYNC	64000	DSU	N/A	N/A	OFF

Configuration 3 Composite Link Configuration

Local Channel Parameter

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
05	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
06	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
07	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
08	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

OK

Configuration 3 Local Site Channel Parameters

Local Channel Parameter

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	XON	OFF	OFF
05	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
06	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
07	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
08	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

OK

Configuration 3 Remote Site Channel Parameters

MultiMux

Chapter 3 - Front & Rear Panel Descriptions

MultiTech®
Systems

3.1   Introduction

This chapter describes all of the front panel LEDs, switches, jumpers
and the shunt on the base and the back panel connectors. The front
panel contains all the LEDs for all the MultiMux MMH900 Series models.
Some of the LEDs on your particular model will not be active, for
example, if you have an internal composite link modem, the External
Composite Link LEDs on the lower left side of the control panel will not
light. Also, on the back panel, not all of the connectors are used in a
given configuration.

3.2   Front Panel

The MultiMux is equipped with a complete set of LED status indicators
and DIP switches located behind the front panel. The status indicators
show precisely what is occurring in the network at all times. By
periodically checking the indicators you can keep abreast of system
activity without tieing up a channel device or using the supervisory
console. The front panel indicators are divided into four main categories;
the Command Modem, External Composite Link device, Internal
Composite Link device and the system status indicators. The function of
each indicator by category is explained in section 3.3.
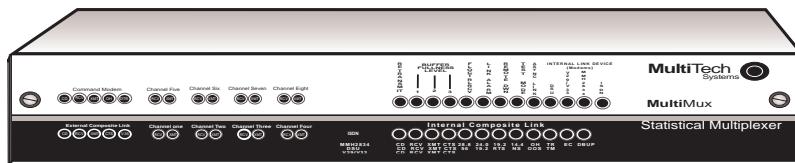
Figure 3-1.   MultiMux Front Panel

3.3 LED Indicators

Command Modem

Indicator   Description

CD   Indicates the local command modem has detected a carrier signal from a remote modem.

RCV/XMT   Indicates that the command modem is on-line by flashing with data activity between the two command modems.

OH   Indicates that the dial-up line for the command modem is off-hook.

DTR   Indicated that the command modem is ready to communicate.

External Composite Link

CD   The Carrier Detect (CD) indicator is used when the MultiMux MMH900 series is configured for an external composite link device and a carrier signal is detected.

RCV/XMT   The Transmit (XMT) and Receive (RCV) indicators are used when the MultiMux MMH900 series is configured for an external composite link device and the network is on-line by flashing with data activity between the two multiplexers.

CTS   The Clear To Send (CTS) indicator is used when the MultiMux MMH900 series is configured for an external composite link device and the composite link device is ready to transmit data.

V.35   The V.35 indicator is used when the MultiMux MMH900 series is configured for an external composite link device which uses a V.35 interface. The V.24/V.35 shunt has to be in the V.35 position for this LED to light.

Channel

Indicator	Description
Channel 1-8	The Channel Receive (RCV) and Transmit **RCV/ XMT**(XMT)indicators show the activity level on each channel.MultiMux MMH904 uses Channel One through Channel Four indicators. The MultiMux MMH908 can connect up to eight async devices which use Channel One through Channel Eight indicators.

Internal Composite Link (MMH2834 Modem)

Indicator	Description
CD	The Carrier Detect (CD) indicator lights when the MMH2834 composite link modem detects a carrier signal from the remote link modem.
XMT	The Transmit (XMT) indicator flashes as data is being transmitted by the MMH2834 modem to the remote multiplexer.
RCV	The Receive (RCV) indicator flashes as data is being received by the MMH2834 modem from the remote multiplexer.
CTS	The Clear To Send (CTS) indicator lights when the MMH2834 composite link modem is ready to transmit data.
28.8, 24.0,	These composite link speed indicators display **19.2, 14.4**the receive baud rate of the internal composite link.
OH	The Off-Hook (OH) indicator lights when the composite link is off-hook
TR	The Terminal Ready (TR) indicator lights when the MMH2834 modem is permitted to answer an incoming call. When the indicator goes off, the connected composite link modem will disconnect.
EC	The Error Correction (EC) indicator is on solid when the MMH2834 modem is in errorcorrection mode and flashes on and off when compression is active.
DBUP	The Dial Back up (DBUP) indicator lights when the MMH2834 modem is in dial back up mode.

Internal Composite Link (DSU)

Indicator   Description

CD
The Carrier Detect (CD) indicator lights when the composite link DSU detects a carrier signal from the remote MultiMux.

XMT
The Transmit (XMT) indicator flashes as data is being transmitted to the remote multiplexer on the composite link.

RCV
The Receive (RCV) indicator flashes as data is being received from the remote multiplexer on the composite link.

CTS
The Clear To Send (CTS) indicator lights when the composite link DSU is ready to transmit data.

56, 19.2
These composite link speed indicators display the baud rate of the internal composite link.

RTS
The Request To Send (RTS) indicator lights when the MultiMux has data it wants to transmit over the composite link

NS
The No Signal (NS) indicator lights when no signal at all is received from the DDS line or when the signal is too weak for normal operation. This indicator will also flash to indicate that errors have been detected when using the Test Pattern diagnostic feature.

OOS
The Out Of Service (OOS) indicator lights when an out of service signal is detected from the teleco.

TM
The Test Mode (TM) indicator lights when the DSU is placed in test mode.

Internal Composite Link (V29/V33 Modem)

Indicator **Description**

CD The Carrier Detect (CD) indicator lights when an internal composite link 9600 or 14,400 bps modem detects a carrier signal from the remote link modem.

XMT The Transmit (XMT) indicator flashes as data is being transmitted from an internal composite link 9600 or 14,400 bps modem to a remote multiplexer.

RCV The Receive (RCV) indicator flashes as data is being received by an internal composite link 9600 or 14,400 bps modem from a remote multiplexer.

CTS The Clear To Send (CTS) indicator lights when an internal composite link 9600 or 14,400 modem is ready to transmit data.

Internal Composite Link (ISDN)

Indicator **Description**

CD The Carrier Detect (CD) indicator lights when the terminal adapter establishes a connection with the remote unit.

XMT The Transmit (XMT) indicator flashes as data is being transmitted to a remote multiplexer.

RCV The Receive (RCV) indine line, or modem problem).Steady when buffer overflow conditions exist.

REMOTE DWN The local mux cannot establish communications with the remote mux.

TEST MODE A device in the network is currently running a maintenance diagnostic.

ASYNC LINK The composite link is configured to transfer data in asynchronous mode.

Internal Link Device (Modems)

Indicator	Description
56K DSU	This indicator lights when the internal link device is a DSU.
V29/V33	This indicator lights when either an internal 9600 bps (V.29) or 14,400 bps (V.33) modem is the composite link device.
MMH2834	This indicator lights when the 28.8K bps internal composite link modem is the composite link device.
ISDN	This indicator lights when the internal link device is the ISDN terminal adapter.

3.4   Back Panel

The cable connections for the MultiMux are made at the back panel. Refer to Chapter 4 for cabling installation procedures. Refer to Appendix C for cabling diagrams. The MultiMux back panel is shown in Figure 3-2.
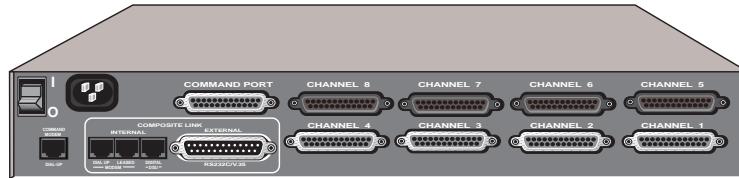
Figure 3-2.   Back Panel

3.4.1   ON/OFF Switch

This switch provides AC power to the MultiMux when placed in the up (ON) position and removes power when in the down position.

3.4.2   Power Connector

The power connector is a receptacle for a 3-prong grounded power cord.

3.4.3   COMMAND MODEM DIAL-UP Connector

This connector is used when the command modem is connected to a separate dial-up line for remote access.

3.4.4   COMMAND PORT Connector

The command port connector is used to connect the supervisory console to the MultiMux MMH900 series. The supervisory console can be either an ASCII terminal or a pc with a serial port running communications software. The command port connector has a DCE physical interface with a DB25 female connector.

3.4.5   COMPOSITE LINK INTERNAL MODEM DIAL-UP Connector

This composite link internal modem connector is used with an internal composite link modem with a dial-up or dial back capability. This connector provides an RJ11 connection.

3.4.6   COMPOSITE LINK INTERNAL MODEM LEASED Connector

This connector is used when the MultiMux MMH900 series is connected to a lease line with an internal Multi-Tech 9600, 14.4K, or 28.8K bps modem installed. The composite link internal modem leased connector provides an RJ11 connection.

3.4.7   COMPOSITE LINK INTERNAL DIGITAL DSU Connector

The composite link internal digital DSU connector is used when the MultiMux MMH900 series is connected to a DDS or dedicated network and an internal DSU is installed. This connector provides an RJ48 connection to the DDS or dedicated network.

3.4.8   COMPOSITE LINK EXTERNAL RS232C/ V.35 Connector

This connector is used when an external modem or DSU is connected to the MultiMux MMH900 series. This connection can be either RS232C or V.35. If the connection is V.35, then the shunt must be moved from the RS232C position to the V.35 position. This connector is a DB25 female connection.

3.4.9   CHANNEL 1 - CHANNEL 8 Connectors

Channel 1 through channel 8 connectors are used to connect the async devices to the MultiMux MMH900 series. The MultiMux MMH904 has four channel connectors. The MultiMux MMH908 has eight channel connectors. These connectors provide the RS232C connection.

3.5   Switches/Jumper/Shunt

Switch settings can be changed by taking off the front panel. To change the   RKWL/144 jumper, V.24/V.35 shunt, V.29/V.33 shunt, or the 2834 shunt, the front panel and top cover need to be removed. The switches, jumper and shunts are shown on the base in Figure 3-3.
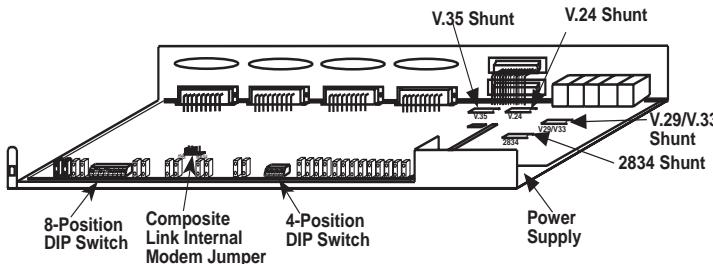
Figure 3-3. Base

3.5.1   8-Position DIP Switch

The 8-position DIP switch is shown in Figure 3-3 and the function of each position is as follows:

Switch position 1:   Closed   Initiate Downline Load Off
Open (UP) Initiate Downline Load On
(used for downline loading only)

Switch position 2:   Closed   External Link Device Selected
Open (UP) Internal Link Device Selected

Switch Position 3:   Closed   Four Channel Operation
Open (UP) Eight Channel Operation

Switch Position 4:   Closed   Disable Command Modem Remote
Access
Open (UP) Enable Command Modem Remote
Access (default)

Switch Position 5:   Not Used

With an MMH904 Unit

C = Closed   O = Open (Up)

Channel #	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32
Switch Position 6:	C	O	C	O	C	O	C	O
Switch Position 7:	C	C	O	O	C	C	O	O
Switch Position 8:	C	C	C	C	O	O	O	O

With an MMH908 Unit

Channel #	1-8	9-16	17-24	25-32
Switch Position 6:	C	O	C	O
Switch Position 7:	C	C	O	O
Switch Position 8:	C	C	C	C

3.5.2   4-Position DIP Switch

The four-position DIP switch determines the type of MultiMux at the other end of the composite link.   The function of the switch is as follows:

Remote Mux	MM16/32	MM900	MMH16/32	MH900
Switch Position 1:	O	C	O	C
Switch Position 2:	O	O	C	C
Switch Position 3:	Not Used			
Switch Position 4:	Not Used			

3.5.3   144RKWL/OtherJumper

The 144 RKWL/OTHER jumper is positioned in the 144RKWL (Rockwell) position when a 14,400 Rockwell internal composite link modem is used. When any other internal composite link modem or DSU is used, this jumper is in the OTHER position. The location of the jumper on the base is shown in Figure 3-3 and the placement of the jumper is shown in Figure 3-4.

OTHER/144RKWL
All other Internal
composite link
modems installed

(Factory Default)

OTHER/144RKWL
14400 Rockwell
Modem Install

(Optional Setting)

Figure 3-4. 144RKWL/Other Jumper

3.5.4   V.24/V.35 Shunt

An external composite link device with either an RS232C/V.24 or a V.35 interface can be connected to a MultiMux MMH900 series. When an external composite link device with an RS232C/V.24 interface is connected to the MultiMux, the V.24 shunt should be installed. When the external composite link device has a V.35 interface, the V.35 shunt should be installed. The V.24/V.35 shunt is shown in Figure 3-3. The factory default for the shunt is in the V.24 position.

3.5.5   V.29/V.33 Shunt and 2834 Shunt

When an internal modem is being installed, the V.29/V.33 shunt or the 2834 shunt has to be in the correct position. This shunt is shown in Figure 3-3. If a V.29 or V.33 modem is being installed, the shunt has to be in the V.29/V.33 position. If a MMH2834 modem is being installed, the shunt has to be in the 2834 position. If an internal ISDN terminal adapter is installed, the shunt must be in the 2834 position.

MultiMux

Chapter 4- Installation

MultiTech
Systems

4.1   Introduction

This chapter explains how to unpack and install your MultiMux cabinet.

4.2   Safety Warnings

1.   Never install telephone wiring during a lightning storm.

2.   Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.

3.   Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.

4.   Use caution when installing or modifying telephone lines.

5.   Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.

6.   Do not use the telephone to report a gas leak in the vicinity of the leak.

4.3   Unpacking

Unpack and check all the items in the MultiMux shipping list to ensure
that you have received the correct options and accessories.

MultiMux Components

A. MultiMux Cabinet

B. Owner's Manual

C. Power cord

D. RJ11 phone cable (for internal modem)

E. RJ48 phone cable (for internal DSU)

F. Mux Converter Cable (for internal ISDN terminal adapter)

G. Composite Link cable (for external modem)

Inspect the MultiMux cabinet for visible shipping damage. If damage is
observed, do not power-on the unit; contact Multi-Tech's Tech Support
for advice. If no damage is observed, place the MultiMux cabinet in its
final location.

Save the packing material for possible future use (e.g., return or
relocation).

4.4   Installation Procedure

Composite Link

Step   Procedure

1   If your MultiMux has an internal link modem and you are connecting to a dial-up service, connect the RJ11 cable to the COMPOSITE LINK INTERNAL MODEM DIAL-UP connector on the back panel of the MultiMux and your phone line.

If your MultiMux has an internal link modem and you are connecting to a lease line service, connect the RJ11 cable to the COMPOSITE LINK INTERNAL MODEM LEASED connector on the back panel of the MultiMux and your phone line.

If your MultiMux has an internal link DSU and you are connecting to a DDS or dedicated service, connect the RJ11 cable to the COMPOSITE LINK INTERNAL DIGITAL connector on the back panel of the MultiMux and your phone line.

If your MultiMux has an internal link ISDN terminal adapter, connect the Mux Converter cable supplied with the unit to the COMPOSITE LINK INTERNAL DIGITALconnector on the back panel of the MultiMux and your phone line.

If your MultiMux is being connected to an external modem with an RS232C interface, connect the composite link cable shipped with your MultiMux to the COMPOSITE LINK EXTERNAL RS232C/V.35 connector on the back panel and to the RS232 connector on the external modem.

If your MultiMux is being connected to an external modem with a V.35 interface, connect a V.35 interface adapter cable Multi-Tech (#90056210) to the COMPOSITE LINK EXTERNAL RS232C/V.35 connector on the back panel and to the V.35 connector on the external modem.
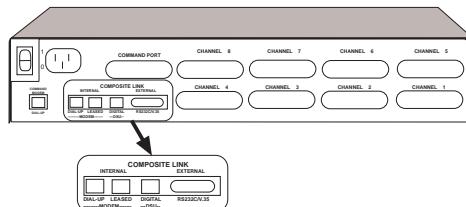
Figure 4-1. Composite Link Cabling

Step   Procedure

If an external modem with V.35 interface is being connected, remove the top cover and move the V.24/V.35 shunt from the V.24 position to the V.35 position. Replace the top cover.
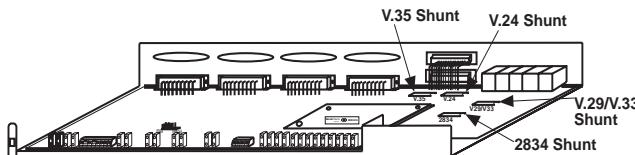
Figure 4-2. Shunts

2   Connect the AC power cord shipped with your MultiMux to the AC power connector on the back panel and to the AC outlet.

3   Press the power ON/OFF switch on the back panel of the MultiMux to apply power.

4   If the internal composite link modem is V.34/28800 bps, verify that the INTERNAL LINK DEVICE Modem MMH2834 LED on the front panel is ON.

If your MultiMux is configured for an external composite link sync modem, verify that the External Composite Link XMT and CTS LEDs are ON. If the external composite link modem has a V.35 interface, verify that the V.35 LED is also ON.

If a DSU is installed in your MultiMux, verify that the 56K DSU LED is ON.

Supervisory Console

5   If you are connecting a supervisory console to the MultiMux, connect a terminal or PC to the COMMAND PORT connector via an appropriate RS232C cable. The PC needs to be running communications software.

Note: Any cables connected to the computer should be shielded to reduce interference.
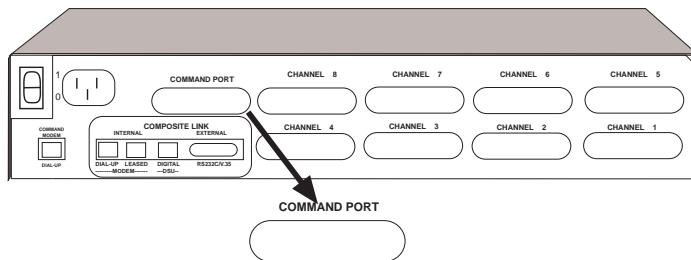
Figure 4-3. Supervisory Console Cabling

6   Apply power to the supervisory console and enter AT and then hit Return. If you get an OK message back, you are communicating with the Command Port..

Command Modem

7   To connect the built-in command modem to a standard phone line, connect the RJ11 cable to the COMMAND MODEM DIAL-UP connector on the back panel of the MultiMux and the phone jack.
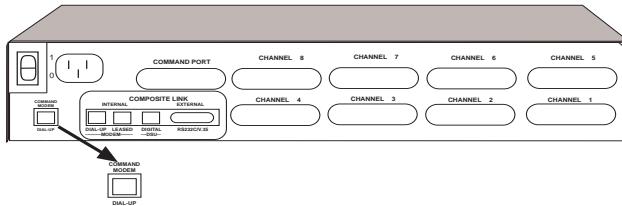
Figure 4-4. Command Modem Cabling

Channel

8   Route and connect your channel devices to the MultiMux back panel
     CHANNEL 1 - CHANNEL 4 on a MultiMux MMH904 or CHANNEL 1
     - CHANNEL 8 on aMultiMux MMH908 connectors using RS232
     cables. Do this at both of your sites, so that channel 1 at one site
     communicates with channel 1 at the other site, and so on.

Note: Any cables connected to the computer should be shielded to
     reduce interference.

Follow channel device guidelines regarding RS232 cable lengths
and make sure that the pin assignment in Appendix C of this manual
are followed.
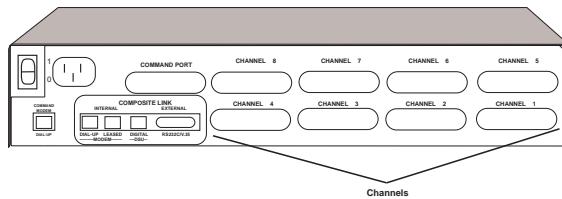
Figure 4-5. Channel Cabling

9   Execute the parameter display command to display the current
     channel parameter status for your local MultiMux by entering the
     following:

ATL (hit Return)

The following will be displayed on your supervisory console for a
MultiMux MMH904:

Local Channel Parameter

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

10 Based on the listed conditions for each channel, reconfigure the parameters to match your actual channel requirements by entering commands as described in Chapter 4.

As you change operational parameters, they will not actually be incorporated into your running system until you execute a Store New Parameters (**&W**).

As you change operational parameters, they will not actually be incorporated into your running system until you execute a Store New Parameters **(&W)** command.

MultiMux

Chapter 5 - Commands

MultiTech®
Systems

5.1 Introduction

This chapter presents a command summary followed by a detailed description of each command used in the MultiMux. The structure of the commands is that they all begin with the prefix AT. Each command line may contain any number of commands in a string (no spaces) up to a limit of 40 characters. Most commands include a value and are part of the 40 character total. Hitting Return executes a command line but does not incorporate it into the operation of your MultiMux. You must execute a Store New Parameters command to implement your changes into your mux network.

An example of a command line which changes the parameters of the channel device connected to channel 1. The following command changes the baud rate to 4800 bps, parity to odd, CTS flow control and turns echo off.

ATC1B4800P2F1E0

Table 5-1 presents a summary of all the commands used in the MultiMux. The commands are divided into a number of general categories according to their functionality within the MultiMux. This functional division is carried on into the detailed description of each command.

The access commands for the command modem are described in this chapter. The general AT commands for the command modem are described in Appendix D.

Table 5-1. Command Summary

TYPE	COMMAND	DESCRIPTION
General	**H**	General Help
	H1	Channel Parameter Help
	H2	DIP-Switch ConfigurationHelp
	H3	Async/Sync Composite Link Format Help
	H4	Additional Composite Link Help
	H5	Miscellaneous Help
	H6	Internal V.29/V.33 Composite Link Modem Configuration Help
	H7	Internal DSU Help
	Z	Reset
	&W	Store New Parameters to Memory

Table 5-1. Command Summary (cont.)

TYPE	COMMAND	DESCRIPTION
Channel	**B0**	Channel Off Command
Parameter	**Bxxx**	Baud Rate Select
	C0	Universal Channel Parameters Command
	C1-C8	Channel Select for Parameter Change
	DCx	Destination Channel
	DNx	Destination Node Number
	E0	Echo Off
	E1	Echo On
	F0	Flow Control Off
	F1	CTS (RS232C) Flow Control
	F2	Xon/Xoff Flow Control
	F3	Enq/Ack On
	F4	EnqAck Off
	F5	Pacing On
	F6	Pacing Off
	F7	Pass EIA (RS232C) Signals On
	F8	Pass EIA (RS232C) Signals Off
	F9	Xon Pass Thru On
	F10	Xon Pass Thru Off
	F11	Inverter DTR On
	F12	Inverter DTR Off
	F13	Xoff/First Character Pacing
	F14	Xoff/Xon Character Pacing
	F15	XPC Flow Control On
	F16	XPC Flow Control Off
	I0-2	Identification Commands
	L,L0	List all Channel Parameters
	L1-L8	List individual Channel
	P0	Parity None
	P1	Parity Odd
	P2	Parity Even

Table 5-1. Command Summary (cont.)

TYPE	COMMAND	DESCRIPTION
Channel	R0-3	Response Time Priority
Parameter	SB1	Stop Bit 1
	SB1.5	Stop Bit 1.5
	SB2	Stop Bit 2
	SN	Local Source Node Number
	WL5	Word Length 5
	WL6	Word Length 6
	WL7	Word Length 7
	WL8	Word Length 8
	&F	Load Factory Defaults
	&SL	Select Local Parameter
	&SR	Select Downline Parameters
	#S1-8	Channel Status Reports
Composite Link		
	#C	Clear Composite Statistics
	#CLA	Composite Link Access
	$F	Load Factory Defaults for DSU and ISCC
	#FT	Flush Timer Value
	$L	List Composite Link Configuration
	#L	List Composite Link Settings
	#RB	Set Auto reporting Baud Rate
	#RT	Set Auto Reporting Time Interval
	#S	Status Reporting
	#S9	Status of Front Panel LEDs
Composite Link Format		
	#EOFR	Receive End Of Frame Character
	#EOFT	Transmit End Of Frame Character
	$MUXCL	Mux Clock
	$MUXSP	Mux Speed
	#SYNC	Synchronous Composite Link
	#ASYNC	Asynchronous Composite Link

Table 5-1. Command Summary (cont.)

TYPE	COMMAND	DESCRIPTION

Internal 9600/14.4K Composite Link Modem

	$MC	Modem Configuration Select
	$EP	Echo Protect Tone
	$LA	Link Amp Set
	$LD	Link Delay Set
	$CQ	Cable Equalization
	$RL	Receive Level
	$TL	Transmit Level
	$T	T/2 Adaptive Equalizer
	$W	Write Configurations to modem

Internal MMH2834 Modem Configuration

	$M(ASYNC/SYNC)	MMH2834 Sync or Async Mode
	$M(DIAL/LEASED)	Dail up or leased line
	$MWIRE(2/4)	2 or 4 wire leased line
	$MTL(0/10)	Transmit Level 0 or -10 db
	$M (ANSWER/ORIGINATE)	Lease Line Answer or Originate Mode
	$MCOMMAND	Enables or disables Command Mode
	$MTR	Data Transmission Rate

Internal DSU

	$DSUCL	Selects Clocking for Internal DSU
	$DSUSP	Selects Speed of Internal DSU
Test	&T1-3	Memory Tests
	&T4	Local Loop
	&T5	Digital Loop
	&T6	Remote Analog Loop
	&T7	Switch and LEDs
	&T8	Memory Test
	&T9	Watch Dog Timer Test
	&T10	Internal Modem Memory Test

Table 5-1. Command Summary (cont.)

TYPE	COMMAND	DESCRIPTION
Command		
Modem	**#MA**	Command Modem Select
	#RA	Remote Command Modem Access

5.2   Command Description

The following command descriptions explain the effect that executing
each command has on your MultiMux network. Refer to Chapter 6 for
instructions on how to execute the commands.

5.2.1   General Commands

Z   **Reset**

> The Reset command will set the operating
> parameters of the MultiMux to its most recently
> stored values. Executing the Reset command
> performs the same function in the logic as turning
> power off and then on to the unit.

&W   **Store New Parameters**

> The Store New Parameters command causes the
> MultiMux to store new parameters. Prior to
> executing the **&W** command, any changes to
> MultiMux parameters are temporary and do not
> affect the unit's operation until you execute the **&W**
> command followed by a reset **Z** command. The **&W**
> command stores the parameters in nonvolatile
> memory and will take affect upon reset or powering
> the MultiMux off and on.

H, **H1-H8**   **Help**

> The Help commands are designed to give you short
> explanations on how to use MultiMux commands.
> They will be useful if your manual is not handy,
> although the explanations are quite short in
> comparison to those in the manual. When a Help
> command is executed in conjunction with some
> other command, the resulting display will explain
> options and information for that command. The
> General Help command provides information on the
> other MultiMux Help commands.

The H command menu is as follows:

General Help

1. Each command line must begin with the prefix AT.

2. Each command line may contain any number of commands up to 40 characters total.

3. Most command letters must be followed by a value.

4. For help on specific commands, enter "ATH" followed by the command letters.

5. For additional help menus, enter "ATH" followed by numbers 1-7.

    A. Type ATH or ATH0 for General Help.

    B. Type ATH1 for channel parameter commands.

    C. Type ATH2 to view the DIP switch configurations.

    D. Type ATH3 for async and sync composite link format commands.

    E. Type ATH4 for additional composite link commands.

    F. Type ATH5 for miscellaneous commands.

    G. Type ATH6 for internal V.29/V.33 composite link modem commands.

    H. Type ATH7 for internal DSU commands.

    I. Type ATH8 for internal MMH2834 modem commands

H1 Menu

CHANNEL PARAMETER COMMANDS

B	BAUD RATE SELECTION
P	PARITY SELECTION
C	CHANNEL SELECTION
R	RESPONSE TIME PRIORITY
DC	DEST. CHANNEL SELECTION
SB	STOP BIT SELECTION
DN	DEST. NODE SELECTION
SN	LOCAL SOURCE NODE NUMBER
E	LOCAL ECHO
#S	CHANNEL STATISTICS
F	FLOW CONTROL
&SL	SELECT LOCAL PARAMETERS
&F	READ IN FACTORY DEFAULTS
&SR	SELECT DOWNLINE LOAD PARAMETERS
L	LIST PARAMETERS
WL	WORD LENGTH SELECTION

THE FOLLOWING EXAMPLE WILL SELECT CHANNEL 1 AND SET ITS BAUD RATE TO 2400 AND THE WORD LENGTH TO 8 BITS:

ATC1B2400WL8 <ENTER>

FOR HELP ON A SPECIFIC COMMAND, ENTER "ATH" FOLLOWED BY A COMMAND LETTER

H2 Menu

MULTIMUX Eight Position DIP-Switch Definitions and Settings

Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6, Switch 7, Switch 8		
Initiate	Link	8/4	Remote	Not	Channel Group Select		
Dwn	Device	Channel	Access	Used	When MM16 or MMH16		
Line					Series is selected		
Load							

UP = ON	INTERNAL	8 CHAN	ENABLED		SEE TABLE BELOW		
DN = OFF	EXTERNAL	4 CHAN	DISABLED				

CURRENT SETTINGS:

	DN	DN	DN	DN	DN	DN	DN	DN
	1 - 4	5 - 8	9 - 12	13 - 16	17 - 20	21 - 24	25 - 28	29 - 32
SW#6	DN	UP	DN	UP	DN	UP	DN	UP
SW#7	DN	DN	UP	UP	DN	DN	UP	UP
SW#8	DN	DN	DN	DN	UP	UP	UP	UP
	1 - 8	9 - 16	17 - 24	25 - 32				
SW#6	DN	UP	DN	UP				
SW#7	DN	DN	UP	UP				
SW#8	DN	DN	DN	DN				

Note: Hit any key to display four position DIP Switch or control C to abort MultiMux four position DIP Switch definitions and configurations.

Switch 1	Switch 2	Switch 3	Switch 4
Mux Mode	Mux Mode	Not	Not
Select	Select	Used	Used

UP =	16/32 MM
DN =	900 MMH/MMV

Current Setting:

DN	DN	DN	DN

H3 Mendu

COMPOSITE LINK FORMAT COMMANDS

#EOFR - SELECTS RECEIVE END OF FRAME CHARACTER FOR ASYNC LINK.

#EOFT - SELECTS TRANSMIT END OF FRAME CHARACTER FOR ASYNC LINK.

$MUXCL - SELECTS INT/EXT CLOCKING OF MUX COMPOSITE LINK.

$MUXSP - SELECTS SPEED OF MUX COMPOSITE LINK WHEN MUX CLOCKING IS INTERNAL OR ASYNC LINK IS SELECTED.

#SYNC - SELECTS SYNC COMPOSITE LINK

#ASYNC - SELECTS ASYNC COMPOSITE LINK

FOR HELP ON A SPECIFIC COMMAND, ENTER "ATH" FOLLOWED BY THE COMMAND LETTER

EXAMPLE: ATH$MUXCL "ENTER"

H4 Menu

COMPOSITE LINK COMMANDS

#C	CLEAR COMPOSITE STATISTICS
#CLA	COMPOSITE LINK ACCESS
#DTR	TOGGLE DTR ON THE COMPOSITE LINK
$F	LOAD FACTORY DEFAULTS FOR DSU AND ISCC
#FT	FLUSH TIMER VALUE
$L	LIST COMPOSITE LINK CONFIGURATION
#L	LIST COMPOSITE LINK SETTINGS
R	RESPONSE TIME PRIORITY
#RB	SET AUTO REPORTING BAUD RATE
#RT	SET AUTO REPORTING TIME INTERVAL
#S	STATUS REPORTING
#S9	STATUS OF FRONT PANEL LEDS

FOR HELP ON A SPECIFIC COMMAND, ENTER "ATH" FOLLOWED BY A COMMAND LETTER.

H5 Menu

MISCELLANEOUS COMMANDS

I	ID CODE
#MA	MODEM ACCESS FOR COMMAND MODEM
#RA	REMOTE ACCESS FOR COMMAND MODEM
&T	TEST MODES
&W	SAVE PARAMETERS "WRITE TO MEMORY"
Z	RESET MULTIMUX

FOR HELP ON A SPECIFIC COMMAND, ENTER "ATH" FOLLOWED BY A COMMAND LETTER.

H6 Menu

Commands to configure the MultiMux Internal V29/V33 modem

$CQ	CABLE EQUALIZER
$EP	ECHO PROTECTOR CONTROL
$F	READ IN FACTORY DEFAULTS FOR MODEM
$L	LIST INTERNAL MODEM PARAMETERS
$LA	LINK AMPLITUDE EQUALIZER
$LD	LINK DELAY EQUALIZER
$MC	MODEM SPEED CONFIGURATION
$RL	MODEM RECEIVE LEVEL
$TL	MODEM TRANSMIT LEVEL
$T	(T/2) ADAPTIVE EQUALIZER
$W	WRITE CONFIGURATIONS TO MODEM #DOES NOT SAVE#

H7 Menu

INTERNAL DSU COMMANDS

#DSUCL	SELECTS CLOCKING FOR INTERNAL DSU.
#DSUSP	SELECTS SPEED FOR INTERNAL DSU.

FOR HELP ON A SPECIFIC COMMAND, ENTER "ATH" FOLLOWED BY A COMMAND LETTER.

H8 menu

INTERNAL MMH2834 COMMANDS

$M(ASYNC/SYNC)	SYNC OR ASYNC.
$M(DIAL/LEASED)	DIAL UP OR LEASE LINE
$MWIRE(2/4)	2 OR 4 WIRE LEASE LINE
$MMTL(0/1)	TRANSMIT LEVEL 1 OR -10DB
$M(ANSWER/ORIGINATE)	ANSWER OR ORIGINATE MODE FOR LEASED LINE
$MCOMMAND(0/1)	ENABLE OR DISABLE COMMAND MODE
$MTR(28800/91200 /1440/9600)	DATA TRANSMISSION RATE

FOR HELP ON A SPECIFIC COMMAND, ENTER "ATH" FOLLOWED BY A COMMAND LETTER

5.2.2   Channel Parameter Commands

Command	Description
BO	**Channel Off Command**

The channel off command turns the selected channel off. This command turns off a particular channel or all channels depending on the command. This allows the more efficient use of the dynamically allocated buffers and allows the multiplexer to skip the scanning of unused channels.

Bxxxx	**Baud Rate Select**

The Bxxxxx command selects the bps rate on the indicated channel. The channel bps rate is from 300 bps to 38.4K bps.

CO	**Universal Channel Parameters**

The Universal Channel Parameters command incorporates the commands that follow it (all prior to a Carriage Return) into all the channels. This allows you to change such conditions as baud rate, word length, parity and flow control on all channels by executing a single command.

C1-C8	**Channel Select**

The Channel Select command selects an individual channel on which subsequent commands can operate. The Channel Select command must precede any of the other commands but remains in effect until changed. This is so that a string ofcommands can be entered without preceding each one with a **Cx** command.

DCxx   **Destination Channel Number**

This command is not necessary when a MultiMux 900 Series is connected to another MultiMux 900 series. The Destination Channel Number command **DCxx** is necessary when an MMH904/MMH908 is connected to a MultiMux16 or MultiMux 32 model.

The **DCxx** command specifies the destination channel to which the source channel is communicating. A specific channel can only communicate with one other channel. On multinode networks, this command must be entered at both channel locations specifying each other as destinations (channels can pass through two nodes to get to its destination). On point-to-point networks, this parameter can be downline loaded.

DNxx   **Destination Node Number**

This command is not necessary when a MultiMux 900 Series is connected to another MultiMux 900 Series. The destinatnion Node Number **DNxx** is necessary when MMH904/MMH908 is connected to a MultiMux16 or MultiMux32 model.

The **DNxx** command specifies the node number of the destination node for output operations from a local node. It specifies the destination node of the channels to which the local source channels will connect. For example, if some node in your network is assigned 01 as its number (a node where its SN command was SN01), you can communicate with the 01 location channels by executing a **DN01** command. At that point, your local channels will communicate with those at node 01. The specific channel connections will be determined by the "virtual" channel number you have set up with the 8-position DIP-Switch SW6, SW7, and SW8.

EO-1   **Echo Command**

The **E0-E1** commands turn on and off the echoplex feature of the MultiMux. When the echo condition is on, the data entered on the channel keyboard is returned to the channel display. The purpose of this is so that in interactive operations an operator will not experience undue delays in seeing data appear on the monitor. When the echo condition is off, the keyboard data is not returned to the monitor. **E1** turns on echoplex and **E0** turns it off.

F0-F2   **Flow Control Operations**

Flow Control is the means by which data flow is controlled from the channel devices into the MultiMux. Flow Control is necessary when the data handling capacity of an individual channel cannot keep up with the volume of data sent to it. There are two types of flow control available on the MultiMux. The software based Xon/Xoff and hardware based Clear to Send (CTS). **F0** turns flow control off, **F1** selects CTS flow control, and **F2** selects Xon/Xoff flow control. The way channel devices control the data flow to them from the MultiMux is called Pacing (see Pacing command).The combination of Flow Control for regulating data from individual channel devices and pacing for regulating data to individual channel devices is how data transfers are regulated so that no data is lost.

MUX INITIATED FLOW CONTROL

```
Channel        DATA
Device    ──────▶    Mux
```

Flow control stops the input of data to the mux

CHANNEL DEVICE INITIATED PACING

```
              DATA      Channel
Mux      ──────▶        Device
```

Pacing stops the output of data from the mux
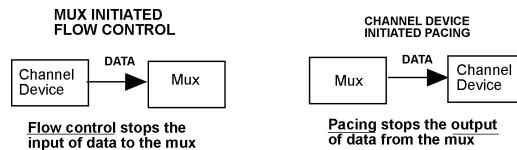
F3-F4	**ENQ/ACK Flow Control**

These two commands control the selection of a special flow control system used in Hewlett Packard computer systems. It is sometimes referred to as Enquire/Acknowledge flow control because it's based on the computer sending an inquiry (ENQ) and then expecting an acknowledgment (ACK). **F3** turns on this feature and **F4** turns off the feature.

F5-F6	**Pacing Control**

The Pacing Control command (**F5**-on, **F6**-off) is the means used to control data flow to channel devices. Pacing is necessary when devices operating on a mux channel require more than one character time to process the data, the pacing commands initiate control so that data is not lost in the transfer process. The MultiMux is shipped with pacing off and it will have to be turned On if your channel device cannot accommodate the data volume.The pacing method used is determined by the type of flow control.

F7-F8   **Pass EIA Signals**

The Pass EIA Signal commands **(F7**-on, **F8**-off) are the commands that enable or disable individual channels to receive EIA control signals through the MultiMux. Since in normal interactive operations, the existence of a multiplexer should be transparent to individual users, the Pass EIA Signals command will allow terminals to operate as if they were connected directly to a communications line and not through a multiplexer. This is done by allowing selected pins (signals) on one mux to be passed through to selected pins (signals) on a second remote mux. The following diagram shows how the Pass EIA Signals command routes the selected signals:

F9-F10 **PassXon/Xoff**

The Pass Xon/Xoff commands, (**F9**-enable, **F10**-disable), are active only if Xon/Xoff flow control is active. Also called the "Pass Through" commands, they enable or disable the MultiMux from passing through Xon/Xoff flow control signals. In the Enable mode, the MultiMux will obey the Xon/Xoff commands and pass them on to the channel device. When this command is enabled, a message "TO PREVENT DATA LOSS TO A PRINTER OROTHER PERIPERAL WE RECOMMEND USING FLOW CONTROL AND PACING, NOT PASS XON," is sent to the channel device. In the Disable mode, the MultiMux will obey the Xon/Xoff commands and not send them to the channel device. The default condition is for Xon/Xoff Pass Through to be disabled and it normally should remain disabled. However, in situations such as a slow data rate of a channel device, disabling the passing of Xon/Xoff signals may improve throughput by utilizing buffers in the mux.

F-11-F12 **Inverted DTR**

The Inverted DTR Commands (**F11** and **F12**) work in conjunction with Pacing Control and change the way the MultiMux reacts tothe DTR signal. With Xon/Xoff Flow Control and Pacing, you will end up with Xon/Xoff Pacing, and with CTS Flow Control plus Pacing, data flow will be controlled by the presence of the DTR (pin 20) signal on the RS232 interface. **F11** turns on Inverted DTR so that a high signal stops data flow and a low starts data flow. **F12** turns off Inverted DTR so that it acts normal (high on and low off). If Flow Control is off, Pacing cannot be turned on. If Pacing is off, inverted DTR cannot be turned on.

F13-F14   **Xoff/First Char.**

F13 is a special pacing command that is called X/off First Character pacing. Selecting **F13** causes the MultiMux to stop data flow to the channel device upon receipt of a Xoff Character. The next character from the channel device will start data (it does not have to be an Xon Character). **F14** will turn off this feature.

F15-F16   **XPC**

XPC is a special flow control that is used with the Xon/Xoff flow control. This flow control command changes the characters for stopping and starting data to 65H and 67H. **F15** enables XPC flow control. **F16** disables XPC flow control.

I0-1   **Identification Commands**

The Identification commands identify the type of MultiMux. This information is valuable when communicating with Multi-Tech's Technical Support personnel about your unit or its performance. The **I0** command identifies the product. The **I1** command indicates the unit's firmware type.

L-L0, L1-L8   **List Channel Parameters**

The List Channel Parameters command causes the MultiMux to display the condition of the parameters for each channel on the system's supervisory console as shown in the following example. To display the parameters for an individual channel, say channel three, you would enter **ATL3** and hit your Return key.To display the parameters for all of the channels, enter **ATL0** and then hit your Return key.

Local Channel Parameter

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

PO-2   **Parity Select**

The Parity Select commands set the parity of the MultiMux operations. Under normal operations (default conditions) parity is off and the word length is set at eight bits. Since the MultiMux is intended to be transparent to channel device operation, this combination will pass parity information to the channel devices.The **P0** command turns parity off, **P1** sets odd parity and **P2** setsit at even.

R   **Response Time Priority**

The Response Time Priority command determines how long the mux will wait to send data from channel devices relative to each other. An **R0** setting is the shortest and **R3** the longest. The function of the Response Time Priority commands is to ensure that channel operations which require heavy data transfers, such as program transmissions or print operations, do not use too much of the buffer and reduce the throughput of the other channels to unsatisfactory levels. In such cases, the interactiveuser who needs immediate responses would experience unreasonable delays. The Response Time Priority numbers 0,1, 2, and 3 establish the relative time each channel must wait for data. The lower the number the shorter the wait. An **R3** number is the most efficient for throughput (allows more data to be assembled before sending a block) so if your mux is used mainly for printing an **R3** setting is the best. **R0** provides the fastest response time so that your interactive users should use an **R0** setting. If the mux is configured mainly for interactive users, **R0** is the best setting.

SB1,SB1.5, SB2   **Stop Bits**

The Stop Bit commands set the number of stop bits used in asynchronous characters. The default condition is one stop bit **SB1**. An **SB1** command sets one, an **SB1.5** command sets 1.5, and an **SB2** command sets two stop bits.

SN	**Source Node Number**

This command is not necessary when a MultiMux 900 Series is connected to another MultiMux 900 Series. **SN** is necessary when an MMH904/MMH908 is connected to a MultiMux 16 or MultiMux32 model. The **SN** command specifies the node number of the local node. This number is determined by you and can be any decimal number up to 255. It should be assigned when you are designing your network and needs to be unique to any other node in your network. Remember that the node number selected will be used by other nodes (using a DNxxx command) when accessing the node. For example, if you assign124 as the **SN** of a local node (**SN124** command), accessing thatnode from another node requires 124 in the other nodesDestination Node's number command (DN124).

WL5-8	**Word Length Select**

The Word Length Select commands set the word length for asynchronous communications. The selections available are 5, 6, 7, and 8 bits which correspond to **WL5** through **WL8.**

&F   **Load Factory Parameters**

The factory default command resets the MultiMux parameters to their original factory settings. They are as follows:

Channel Speed:	19200 bps
Word Length:	8 bits
Stop Bits:	One
Parity:	None
Flow Control:	XON/XOFF
Enq/Ack Control:	Off
Echo:	Off
Pacing:	Off
Pass EIA:	Off
Pass Xon/Xoff:	Off
Response Time Priority:	3

&SL   **Select Local Parameters**

The Select Local Parameters command lists the local channel parameters and enables you to update them. After the execution of this command, all other commands will act on the local parameter set. An **&W** command stores the parameters. When power is turned on, the local parameter mode is in effect.

&SR   **Select Downline Load Parameters**

The Select Downline Load Parameters command lists the remote mux channel parameters and enables you to update them. After execution of this command, all other commands will act on the downline parameter set. To send a new set of parameters to the remote MultiMux unit, 1) the Downline Load switch (8-position DIP switch SW1) must be set properly , 2) then executing an **ATZ** or powering off your unit sends the parameters to the remote mux. Execute an **&W** to store the parameters.

#S1-S8   **Channel Status**

The Channel Status command displays the individual channel percentage activity levels and signal pin status. The status message is displayed in the following format.

STATISTICS FOR CHANNEL NUMBER XX

```
RECEIVE FLOW CONTROL TIME  :  00 HRS  00MIN  00SEC
BUFFER UTILITZATION              :  00%
EIA STATUS:
FLOW CONTROL REQUEST SENT?:  NO
PACING REQUEST RECEIVED?: NO
PIN   #: 4/RTS   5/CTS     6/DSR      8/DCD    20/DTR 22/RI     25/OOS
TYPE  : INPUT   OUTPUT  OUTPUT   OUTPUT  INPUT   OUTPUT INPUT
STATUS : LO     HI          HI          HI          LO        LO          LO
```

5.2.3   Composite Link Commands

The Composite Link commands perform the function of a system monitor. In addition to displaying the information available on the MultiMux's LED display, they also provide additional network statistical information. The purpose of the commands are to allow network monitoring via the supervisory port as an alternative to viewing the LED indicators. The various status commands and their functions are detailed below:

Command   **Description**

#C   **Clear Composite Statistics**

The Clear Composite Statistics command clears the composite statistics record without resetting the entire MultiMux unit.

$F   **Load Modem Default**

The Load Modem Default command returns the status of the internal composite link modem or DSU to its original status as shipped from the factory. The default conditions for a 9600 bps modem are as follows:

Speed:	9600
RCV Level:	-43 dbm
TX Level:	0 dbm
Cable Equalization:	0.0km
Link Amp:	off
Link Delay:	off
T/2 Equalization:	T2
Echo Protect:	off
Test Mode:	off

#FT	Flush Timer Value

This command is necessary when the mux is used with Alpha-Microcomputer and Wyse Terminals. The command allows for the proper use of the function keys as indicated on the keys. The **#FT0** command clears the function and sets the flush time value to 10 msec and **#FT1** sets the flush time value to 20 msec. The default is **#FT0**.

$L   **List Composite Link Configuration**

The List Composite Link Configuration command causes the MultiMux to display its internal composite link parameters on the supervisory console. Five different parameter displays can be shown depending on the internal composite link device. The first example shows the default parameters for a 9600 bps internal modem. Example two shows the 14.4K bps internal modem. The third example shows two sets of parameters for an internal the MMH2834 internal modem. The fourth example shows the MultiMux configured for a 19.2K bps external composite link modem (8-position DIP switch SW2 in the down position). Example five shows the MultiMux configured for an internal composite link DSU.

MODEM CONFIGURE	TXMIT LEVEL	RECV LEVEL	CABLE EQU	LINK AMP	LINK DELAY	T/2 EQU	ECHO PROT	TEST MODE
V29/9600	-0DB	-43DB	0.0KM	OFF	OFF	T2	OFF	OFF

MODEM CONFIGURE	TXMIT LEVEL	RECV LEVEL	CABLE EQU	LINK AMP	LINK DELAY	T/2 EQU	ECHO PROT	TEST MODE
V33/14400	-0DB	-43DB	0.0KM	OFF	OFF	T2	OFF	OFF

LINK DEVICE	LINK FORMAT	MUX SPEED	MUX CLOCKING	BACK TO BACK	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
MMH2834	SYNC	57600	EXTERNAL	OFF	FF	FF	OFF

TRANSMISSION RATE	SYNC ASYNC	DIAL LEASED	2 OR 4 WIRE	ANSWER ORIGINATE	TRANSMIT LEVEL	COMMAND MODE
28800	SYNC	LEASED	4 WIRE	ANSWER	0 DB	ON

LINK DEVICE	LINK FORMAT	MUX SPEED	MUX CLOCKING	BACK TO BACK	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
External	SYNC	19200	EXTERNAL	OFF	FF	FF	OFF

LINK DEVICE	LINK FORMAT	DSU SPEED	DSU CLOCKING	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
DSU	SYNC	56000	DSU	N/A	N/A	OFF

#L	**List Composite Link Settings**

This command lists the status of the link configuration parameters. The display indicates the conditions that affect the link's operation, such as the downline load, modem type, flush timer value and the response time setting.

Local MultiMux Composite Settings

INIATE DOWN LINE LOAD	MODEM TYPE	FLUSH TIMER	RESPONSE TIME
OFF		INTERNAL	10ms	3

#RB	Status Report Baud Rate

This command sets the baud rate of the status report generated by the #S0 command on the system supervisor console display. The speed options are as follows:

#RB300	: 300 bps	#RB120O	: 1200 bps
#RB2400	: 2400 bps	#RB4800	: 4800 bps
#RB9600	: 9600 bps	#RB19200	: 19200bps

#RT0-99	**Status Report Time**

This command sets the time interval in hours at which the status report generated by the #S0 command is displayed on thesystem supervisor console display. The intervals are in hour increments from 1 to 99 hours with **#RT0** being the off condition.

$Muxl	**Inactivity Timer**

The inactivity timer allows the mux to drop DTR which causes the modem to hang up when no characters are received on any channel for the specified time. The timer is enabled with the$Muxl command where the xx is the desired inactivity time in minutes (00-99 minutes). When a character is received on a channel, the mux raises the DTR signal allowing the modem to dial. When the xx is 00, the timer if off. The default for the inactivity timer is off.

#S9   **Composite Link Status Report**

This command generates a status message for display on the system supervisor console display. The message is in the following format:

COMPOSITE STATISTICS

```
ELAPSED TIME                 :          00 DAYS  00 HRS   00 MIN.
BLOCKS TRANSMITTED           :                          0
RETRANSMITS                  :                          0
BLOCKS RECEIVED              :                          0
RECEIVE BLOCK ERRORS         :                          0
LINK ALARMS                  :                          0
REMOTE DOWNS                 :                          0
RECEIVE FLOW CONTROL TIME    :     00 HRS   00 MIN   00 SEC.
AUTOMATIC REPORTING          :          OFF      19200    BAUD
```

#S9   **LED Status**

This command displays the MultiMux front panel LED Status in the following format:

 THIS IS THE CURRENT STATUS OF THE FRONT PANEL LEDS ON MULTIMUX

                        # = ON   BLANK = OFF

```
R    BUFFER        F    L    R    T        COMPOSITE
E    FULLNESS      L    I    E    E        LINK
T    LEVEL         O    N    M    S
R                  C    K    O    T              C
A                  T         T                   A
N                  R    A    E                   R
S                  L    L         M              R
M                  R    A    D    O    C         I
I                  C    R    W    D    T         E
T    1    2    3   V    M    N    E    S         R
     #                  #
```

5.2.4   Composite Link Format Commands

#EOFR   **Receive End Of Frame Character**

The Receive End Of Frame character lets the
MultiMux accept an End of Frame character when
the composite link is in Async mode. When the
composite link is in async mode, the **#EOFRxx**
command determines the End of Frame character
by the hexadecimal value of **xx.** The Receive End
of Frame Character should only be set under the
direction of Tech Support.   The default value for the
MultiMux is that the End of Frame character is FF
hex.

#EOFT   **Transmit End Of Frame Character**

The Transmit End Of Frame character lets the
MultiMux generate an End of Frame character when
the composite link is in Async mode. When the
composite link is in Async mode, the **#EOFTxx**
command determines the End of Frame character
by the hexadecimal value of **xx**. The Transmit End
of Frame Character should only be set under the
direction of Tech Support. The default value for the
MultiMux is that the End of Frame character is FF
hex.

$MUXCL   **Mux Clock**

The Mux Clock command sets the clocking for the
composite link. This command enables the MultiMux
to accept timing from either it's internal timing
oscillator or derive timing from a synchronous full-
duplex external device (**$MUXCLE**). The **$MUXCL**
command is used any time an external link device is
connected to the link. The default condition for the
MultiMux is external clocking.

$MUXSP   **Mux Speed**

The Mux Speed command selects the clocking speed when clocking is provided by the MultiMux. The only time the mux speed needs to be set is when the MultiMux is providing the clocking. The Mux Speed commands are as follows:

$MUXSP 2400	$MUXSP 4800
$MUXSP 7200	$MUXSP 9600
$MUXSP 14400	$MUXSP 19200
$MUXSP 38400	$MUXSP 57600
$MUXSP 64000	$MUXSP 76800
$MUXSP 115200	$MUXSP 128000

$MUXB   **MUX BACK-TO-BACK**

The Mux Back-to-Back (**$MUXB**) command is only used during testing of the composite link when the back-to-back cable is connected between two MultiMuxes. The default value is (**$MUXB0**) and is used during normal operation. In the testing mode with the back-to-back cable connected, the (**$MUXB1**) command is used.

#SYNC   **SYNC**

The Sync command configures the composite link for Synchronous mode. When configuring the composite link for synchronous mode and internal clocking, the Mux Speed command sets the speed of the composite link. If the composite link is in synchronous mode and external clocking is used, the Mux Speed command is not used. The default condition for the composite link is Sync mode.

#ASYNC   **ASYNC**

The Async command is used to set the composite link to Asynchronous mode (**#ASYNC**). When the composite link is configured for Asynchronous mode, the Mux Speed command must be set for the composite link speed. The Mux Clocking command is not used in Asynchronous mode. The default condition for the composite link is Sync mode.

#CLA   **Composite Link Access**

The Composite Link Access command allows you to communicate thru the command port to the composite link. The **#CLA1** command enables the command port to communicate with the composite link in order to reconfigure the composite link device. The **#CLA0** disables access from the command port to the composite link. The default condition is no access to the composite link thru the command port.

#DTR   **Toggle DTR**

The Toggle DTR command (**#DTR**) drops DTR for 500 msec on the composite link. The Toggle DTR command is used for DTR dialing with an external dial-up modem.

5.2.5   Internal 9600/14.4K Composite Link Modem Commands

Command	Description

$MC   **Modem ConfigurationSelect**

This command configures the operations speed at which the internal composite link modem will operate. The possible configurations are as follows.

9600 bps Modem	14.4 Kbps Modem
$MC0: V.29/9600 bps	$MC0: V.29/9600 bps
$MC1: V.29/7200 bps	$MC1: V.29/7200 bps
$MC2: V.29/4800 bps	$MC2: V.29/4800 bps
	$MC3: V.33/14400 bps
	$MC4: V.33/12000 bps

$EP0-2   **Echo Protect Tone**

The Echo Protect Tone command sets the presence and length of the echo protect tones generated by the modem. With an echo protect tone present, the modem will send a tone on the line prior to connection. The **$EP0** command shuts off echo protection on the line. This parameter should be changed only under the direction of Multi-Tech's Technical Support personnel. The echoprotect tone commands are as follows:

$EP0:	off (default)
$EP1:	short at 30 ms
$EP2:	long at 185 ms

$LA0-2   **Link Amplitude**

This command enables cable equalization that compensates for amplitude distortion in the public telephone network that is caused by elements other than the cable to and from the central office. The **$LA1** command compensates for the typical distortion found in a survey done of long distance lines in Japan and the **$LA2** command compensates for conditions based on a survey done in the U.S.

$LA0:   Off (default)

$LA1:   Japan Level

$LA2:   U.S. Level

$LD0-2   **Link Delay**

This command enables cable equalization that compensates for delay distortion in the public telephone network in a similar manner to the amplitude done by the Link Amplitude command.

$LD0:   Off (default)

$LD1:   Japan Level

$LD2:   U.S. Level

$CQ0-3   **Cable Equalization**

The Cable Equalization command incorporates a compromise equalizer that minimizes the effect of how much direct wiring there is in the modem's network. The amount of copper wiring carrying an analog signal affects the data transmissions so that the lower frequencies are attenuated less than the higher frequencies. The longer the cable the more pronounced the effect. Each of these commands will compensate for the effect according to its listed distance. Unless a problem with modem retraining or a high error rate occurs, no equalization will be necessary.

$CQ0: 0.0 km (Default)

$CQ1: 1.8 km

$CQ2: 3.6 km

$CQ3: 7.2 km

$RL0-1   **Receive Level**

The Receive Level Command selects the sensitivity level of the modem to incoming transmissions. The level settings are in dbm increments. The -43 dbm level is the default condition which makes the unit able to receive very low level signals. As the sensitivity becomes less, the modem requires a stronger signal. This parameter should only be changed under the direction of service personnel. The Receive Level settings are as follows:

$RL0:   -43 dbm (default)

$RL1:   -26 dbm

$TL0-7   **Transmit**

The Transmit Level Command selects the level of the modem **Level** output transmissions. The closer the transmit level is to zero the greater the level (strength) of the output signal. This parameter should only be changed under the direction of service personnel. The default condition for the transmit level is 0 dbm. The transmit level settings are as follows:

$TL0:   0   dbm (default)

$TL1:   -2   dbm

$TL2:   -4   dbm

$TL3:   -6   dbm

$TL4:   -8   dbm

$TL5:   -10   dbm

$TL6:   -12   dbm

$TL7:   -14   dbm

$T1-2   **T Level**

This command selects the type of adaptive equalizer used by the receiver. In most cases, a two taps per baud spre`ad over 16 bits gives the best performance because of the increased sample rate and the resulting reduction of alias errors. In cases where the line has ringing or echoing, a one tap per baud spread over 32 bits may be necessary.

$T1:   T/2 with one tap per baud

$T2:   T/2 with two taps per baud (default)

$W   **Write Configurations to Modem**

The Write Configurations to Modem command **($W)** incorporates any updated internal modem parameters into the operation of the internal modem on a temporary basis. This permits you to try various configurations before storing them in memory by executing the **&W** command.

5.2.6   Internal MMH2834 Modem Configuration Commands

The internal MMH2834 modem configuration commands configure the composite link for the internal MMH2834 modem. Additional commands for setting up the modem are provided in Appendix J.

<u>Command</u>	<u>Description</u>

$M   **Internal MMH2834 Modem Sync/Async Mode**

(ASYNC/SYNC)   The sync or async mode of the MMH2834 modem is enabled by the **$M(ASYNC/SYNC**) command.The **$MSYNC** command places the MMH2834 modem in sync mode. The **$MASYNC** command places the MMH modem in async mode. The default value is async mode.

$M(Dial/Leased)   **Internal MMH2834 ModemDial/Leased**

The Dial/Lease Line **$M(Dial/Leased)** command selects the type composite link line the MMH2834 is set for. The **MDial** command places the MMH2834 modem in a dial mode. The **$MLeased** command places the MH2834 modem in lease line mode. The default is dial-up mode.

$MWire(2/4)   **Internal MMH2834 Modem2-Wire/4-WireLease Line**

The 2 or 4 Wire Lease Line **$MWire (2/4)** command places the MMH2834 modem in 2-wire or 4-wire mode. The MWire(2)configures the MMH2834 modem for 2-wire lease line operation.The $MWire(4) configures the MMH2834 modem for 4-wire lease lineoperation. The default value is 4-wire lease line operation.

$MTL(1/10)   **Internal MMH2834 Modem Transmit Level**

The Transmit Level **$MTL(0/10)** command selects the decibel level for output transmissions. The closer the transmit level is to zero the greater the level (strength) of the output signal. This parameter should only be changed under the direction of service personnel. The default condition is 0dbm (**$MTL(0)**).

$M, #M   **Internal MMH2834 Modem Lease LIne Answer/ Originate Mode**

The Answer/Originate Mode **$M(Answer/Originate)** command sets the leade line frequency for the MMH2834 modem originating a call and the remote MMH2834 that is receiving the call. The **#M(Answer)** command places the MMH2834 in answer mode. The default mode for the MMH2834 is answer mode.

$MCommand(0/1) Internal MMH2834ModemCommand Mode

The Command Mode **$MCommand (0/1**) allows you to communicate through the command port to the composite link.The**$MCommand (1)** command enables the command port to communicate with the composite link in order to reconfigurethe MMH2834. The **$MCommand(0)** disables access from the command port to the composite link. The default condition is for access enabled thru the command port to the MMH2834.

$MTR

(28800/19200/   **Internal MMH2834ModemData TransmissionRate**

14400/9600)   The Data Transmission Rate **$MTR(28800/19200/ 14400/9600)**sets the baud rate at which the MMH2834 operates. The **$MTR(28800)** places the MMH2834 composite link at a baud rate of 28.8K bps. The default baud rate is 28800 bps.

Internal MMH2834Modem DTR Dialing

DTR Dialing allows the MMH2834 modem to dial a stored phone number when the mux is reset. A series of AT commands set up DTR Dialing. The following AT commands configure the MMH2834 modem for DTR Dialing:

AT#CLA1 - Access to modem

ATDT (Number Modem to Dial) N0

AT$D1 - DTR Dialing command

AT&W - Store New Parameters to Memory

ATCLA0 - Exist modem command mode

Additional AT commands are described in Appendix D.

5.2.7   Internal Composite Link DSU Commands

Command	Description

$DSUCL   **DSU Clock**

The DSU Clock command allows the internal DSU to accept timing from it's internal timing oscillator (**$DSUCLI**) or from the DDS Network's Receive Bipolar Signal. DDS Clocking command **($DSUCLD)** is used whenever the internal DSU is connected to DDS network line. The **$DSUCLD** command is the factory default and automatically configures the MultiMux clocking.

$DSUSP   **DSU Speed**

The DSU Speed command sets the speed of the internal DSU. The default DSU speed is 56000 bps. The DSU speed commands are as follows:

$DSUSP2400 $DSUSP4800

$DSUSP9600 $DSUSP19200

$DSUSP56000

5.2.8   Test Commands

Command	Description
&T1-2	**MemoryTest**

There are two memory tests available on the MultiMux. The first test **(&T1)** will alter the contents of the basic system memory, which is automatically restored when power is turned on to the system or when a reset command is executed. The second memory test **(&T2)** alters the contents of the memory that stores parameters. When this test is executed, a warning is given that stored parameters will be destroyed. If the Memory Test 2(**&T2**) passes, the factory default parameters will be loaded into your MultiMux.

When executing any of the memory tests, a complete cycle is indicated by a test passed or failed message on the supervisory console. If the test fails, a RAM address is given and the read and write values are shown.

&T 3	Not used.
&T4	**Test Mode 4**

Test Mode 4 is the Analog Loop test which checks the operation of a local MultiMux. This test mode will cause data entered on channel device keyboards to be echoed back to the device's monitor. The entered data goes through the MultiMux plus the digital and analog sides of the internal modem before being returned to the device monitor. This test will not run with an external modem.

&T5	**Test Mode 5**

Test Mode 5 is the Digital Loop test which causes data from the composite link to be echoed through the analog and digital sides of the internal modem and back to the link. This command puts your MultiMux in loop back so the MultiMux at the other end of the composite link can transmit from a channel device and have the information echoed back to the device.

&T6	**Test Mode 6**
	Test Mode 6 is the Remote Analog Loop test which causes any data from the composite link to be echoed through just the analog half of the internal modem back to the link. The function of this command is similar to Test Mode 5 except it checks only the modem's analog circuitry. This test is not used if your MultiMux is configured with a DSU.
&T7	**Test Mode 7**
	Test Mode 7 is the Switch and LED operational test. By running your MultiMux in this test mode, you can switch the eight DIP-switches and verify that they work by corresponding LEDs being lit.
&T8	**Test Mode 8**
	Test Mode 8 is the Non-Volatile Memory test. Its function is to check the proper operation of the MultiMux's battery backed storage of operational parameters. This test will overwrite the stored parameters.
&T9	**Test Mode 9**
	Test Mode 9 is the Watch-Dog Timer test. This test checks the MultiMux's Watch-Dog circuitry. The function of the circuitry is to return the mux to normal operating mode if, for some reason, its operation becomes erratic.
&T10	**Test Mode 10**
	Test Mode 10 is the internal 9600 bps composite modem memory test. When operating properly, this test displays cycle counts of completed read/write cycles on the system supervisor display console.

5.2.9   Command Modem commands

The command modem select and remote access commands are
described in this section. Additional command modem AT commands
are provided in Appendix D.

Command   **Description**

 #MA   **Command Modem Select**

                     The Command Modem Select command (**#MA1**)
                     sends all subsequent commands generated on
                     your supervisory console to the command modem.
                     The various commands for the command modem
                     are AT command set compatible with those
                     described in Appendix D. The **#MA1** command
                     enables the command modem.The **#MA0**
                     command disables the command modem input and
                     hangs up the phone line.

 #RA   **RemoteCommandModem Access**

                     The Remote Command Modem Access (**#RA1**)
                     command allows commands to be received by a
                     MultiMux through it command modem (allows the
                     command modem to answer an incoming call).
                     This permits updating of the mux remotely through
                     the command modem. All commands received on
                     the command modem after calling in will be
                     accepted by the mux as if they were generated by
                     a supervisory console. This condition will exist as
                     long as there is a carrier established. The **#RA0**
                     command disabled remote input through the
                     command modem access (disables Atuo
                     Answering).

MultiMux

Chapter 6- Operating Procedures

MultiTech®
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6.1   Introduction

The following procedures assume that your MultiMuxes (local and remote) have been installed properly and the appropriate channel devices have been connected to each channel.

6.2   MultiMux Operating Procedures

The MultiMux operating procedures cover entering parameters for both your local and remote MultiMux units.

Table 6-1. MultiMux Operating Procedures

Channel

Step   Procedure

1   Turn power on to your MultiMux and supervisory console, type AT and then hit Return. If you get an OK message back, you are communicating with the command port.

2   Execute the parameter display command to display current channel parameter status for your local MultiMux by entering the following:

ATL (hit Return)

The following will be displayed on your supervisory console:

Local Channel Parameter

CHN	SPD	STP WORD	BIT	FLOW PARITY	ENQ/ CONTROL	ACK	ECHO	PASS PACE	PASS EIA	XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

If your MultiMux is communicating with a MultiMux MM16/32 and the 4-position DIP-Switches SW-1 and SW-2 are open, the following screen is displayed . The channel numbers shown in the chart will be the same as those virtual channel numbers selected by the 8-position DIP switch   SW-6, SW-7 and SW-8. A new column (DEST) is added when communicating with a MM16/32 or MMH16/32. Destination channel is set with the DC command.

Table 6-1. MultiMux Operating Procedures (cont.)

Procedure

Source Node #01   Destination Node #02

Local Channel Parameter

CHN	SPD	STP WORD	BIT	FLOW PARITY	ENQ/ CONTROL	ACK	ECHO	PASS PACE	PASS EIA	XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

Step   Procedure

3   To reconfigure the channel parameters to match your actual channel requirements enter commands as described in Chapter 5 or Appendix D of this manual.

4   If you change operational parameters they are not incorporated into your running system until you execute a Store New Parameters (**&W**) command:

AT&W (hit Return)

The parameters will be stored in nonvolatile memory and become effective immediately. When power is turned off, the parameters will be saved.

Table 6-1. MultiMux Operating Procedures (cont.)

Composite Link

Step   Procedure

5   If you wish to display the composite link modem status, execute the Modem Display command by entering the following:

AT$L (hit Return)

The following will be displayed on your system monitor if your MultiMux is configured for a V.34/28800 internal composite link modem:

LINK DEVICE	LINK FORMAT	MUX SPEED	MUX CLOCKING	BACK TO BACK	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
MMH2834	SYNC	57600	EXTERNAL	OFF	FF	FF	OFF

TRANSMISSION RATE	SYNC ASYNC	DIAL LEASED	2 OR 4 WIRE	ANSWER ORIGINATE	TRANSMIT LEVEL	COMMAND MODE
28800	SYNC	LEASED	4 WIRE	ANSWER	0 DB	ON

The following will be displayed on your system monitor if your MultiMux is configured for an external composite link sync modem:

LINK DEVICE	LINK FORMAT	MUX SPEED	MUX CLOCKING	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
EXTERNAL	SYNC	19200	EXTERNAL	FF	FF	OFF

The following will be displayed on your system monitor if your MultiMux is configured with an internal composite link DSU:

LINK DEVICE	LINK FORMAT	DSU SPEED	DSU CLOCKING	EOF XMT CHARACTER	EOF RCV CHARACTER	LOOP BACK
DSU	SYNC	56000	DSU	N/A	N/A	OFF

If the internal composite link modem is either a V.34/28800, the INTERNAL LINK DEVICE Modems MMH2834 LED on the front panel is ON.

If your MultiMux is configured for an external composite link sync modem, the External Composite Link XMT and CTS LEDs are ON.

If the external composite link modem has a V.35 interface, the V.35 LED is also ON. For placement of the V.24/V.35 shunt, refer to the V.24/V.35 Shunt in the Configuration Chapter (Chapter 3) of this manual.

If your MultiMux is configured for an internal composite link DSU, the Internal Composite Link Device DSU LED is ON.

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5 (cont.)

Based on the listed modem status conditions, reconfigure the parameters to the conditions required in your particular installation by entering the appropriate Internal Composite Link Modem Configuration Commands as described in Chapter 5 or Appendix D of this manual. If you wish to save new parameters, you must execute a **AT&W** command.

6   If you wish to display the remote parameter status screen for downline loading, execute the Select Downline Load parameters command by entering the following:

AT&SR (hit Return)

The following will be displayed on your supervisory console:

Downline Load Channel Parameters

CHN	STP SPD	WORD	BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

Note: This display is not a listing of the actual parameters, but shows what can be downline loaded.

7   To reconfigure a channel based on your actual channel requirements, enter commands as described in Chapter 5 or Appendix D of this manual. To save new parameters, you must again execute an **AT&W** command.

Downline Load

8   If you are downline loading remote parameters, your 8-position DIP
     switch SW1 must be in the UP (open) position, refer to the 8-position
     DIP Switch in the Configuration Chapter (Chapter 3) of this manual.
     The other mux in your network must be configured properly and
     have its 8-position DIP switch SW1 in the DOWN (closed) position.
     You then can execute a Reset command (**Z**) to send the new
     parameters to your remote mux unit. An MMH904/MMH908 unit
     cannot down line load parameters to an MM16/MM32 or MMH16/
     MMH32 unit.

9   To return to local parameter display and control, execute a Select
     Local Parameter command by entering the following:

         AT&SL (hit Return)

Status Reporting

10 If you wish to use the status display and auto reporting feature,
     execute the Status Reporting command by entering the following:

         AT#S0 (hit Return)

    The following will be displayed on your system monitor:

ELAPSED TIME	:	00 DAYS 00 HRS 00 MIN.
BLOCKS TRANSMITTED	:	0
RETRANSMITS	:	0
BLOCKS RECEIVED	:	0
RECEIVE BLOCK ERRORS	:	0
LINK ALARMS	:	0
REMOTE DOWNS	:	0
RECEIVE FLOW CONTROL TIME:	00 HRS 00 MIN 00 SEC.	
AUTOMATIC REPORTING	:	OFF 9600 BAUD

    To select the bps rate and time interval at which the above status
    screen will appear, execute a **#RBxx** and **#RTxx** commands as
    described in Chapter 5 or Appendix D of this manual.

6.3   Command Modem Operating Procedures

A wide variety of autodial operations and modem options can be controlled when the command modem is in the command mode. Command modem access commands are described in Chapter 5. Appendix D describes the general AT commands in detail.

Table 6-2. Command Modem Operating Procedures

Step   Procedure

1   Your supervisory console must be set to 2400 bps or less to communicate with the command modem. Execute the Command Modem Select command by entering the following:

AT#MA1 (hit Return)

The following will be displayed on your supervisory console when connected and in command mode:

COMMAND MODEM ACCESS ON

You may now enter the commands for the command modem as described in Appendix D.

2   You can choose to have the "Result Codes" displayed in a "verbose" format (complete English words), or in a "terse" format (single digit numbers). The standard factory format is verbose. If you wish to change to terse format, enter the Result Code Digit command as follows:

ATV0 (hit Return)

You can also choose to completely eliminate the display of all of the Result Codes. This is accomplished by executing a Quiet (**Q**) command.

Before dialing your remote MultiMux, you must make sure that it is ready to accept calls through its command modem. This can be accomplished by having its 8-position DIP switch SW-4 set to the OPEN (UP) position, or a Remote Command Modem Access command (**#RA1**) must be executed on the remote MultiMux unit.

3   You are now ready to dial the phone number of your remote MultiMux. To dial a phone number you use the Dial (**D**) command. You can use Tone (**T**) dialing or Pulse (**P**) dialing and insert Automatic Pauses in Dialing (,) for functions such as dialing through a PBX switchboard. Refer to Appendix D for detailed descriptions of dialing commands.

For example, enter the following to dial a phone number (555-1212) through a switchboard.

ATD9,5551212 (hit Return)

When a carrier signal is detected, the Connect (1) Result Code is displayed.

If no carrier is detected, the No Carrier (3) Result Code is displayed after about 30 seconds.

4   You are now communicating with your remote MultiMux. Any commands you now execute will be done by the remote unit. For instance, to request status of the remote system execute the List Channel Parameters Command by entering the following:

ATL (hit Return)

The following, which will be an actual listing of the remote unit's channel parameters, will appear on your supervisory console:

CHN	SPD	WORD	STP BIT	PARITY	FLOW CONTROL	ENQ/ ACK	ECHO	PACE	PASS EIA	PASS XON
01	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
02	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
03	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF
04	19200	8	1	NONE	XON/XOFF	OFF	OFF	OFF	OFF	OFF

To end your call to the remote site you can either terminate the whole command modem operation and put your supervisory console back into communications with your local MultiMux or you can end the current call and remain connected to your command modem for additional remote communications.

To end the current call and place the supervisory console control back to the local MultiMux, enter the following command:

AT#MA0 (hit Return)

To end the call and remain connected to your command modem, enter the following command:

+++ (hit Return)

Wait for the OK (0) Result code to be displayed on your supervisory console, then enter the following:

ATZ (hit Return)

MultiMux

Chapter 7 - Troubleshooting Procedures

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7.1   Introduction

The MultiMux is designed to make it easy to operate and maintain. The procedures in this chapter will help isolate any problems you have to a specific component of your network, at which point you will be instructed to call the appropriate personnel or execute commands to adjust operating conditions.

There are no specific repair procedures besides command execution and switch settings that you are expected to perform in MultiMux maintenance.

An important part of the MultiMux design is its remote diagnostic capabilities. Our Tech Support department personnel can dial-up your MultiMux through the command modem and execute special diagnostics that will help find problems fast. When you're stuck on a problem, do not hesitate to Technical Support for help. Our staff may have encountered your problem before and can help you quickly. See Chapter 8 of this manual.

7.2   Importance of Composite Statistics

The Composite Link Status Command **AT#S0** provides additional information concerning the operation of your composite link that can aid you in testing for problems. The composite report generated by this command can be very valuable when used in conjunction with Analog Loopback testing. For example, if your REMOTE DWN indicator is on, you could run an Analog Loopback test to make sure the failure is not in the MultiMux. If the test runs correctly, you then can check the composite statistics for additional information.

The data in the composite status report will tell you more about line failure conditions. The following items are on your composite status report:

```
ELAPSED TIME                 :          00 DAYS  00 HRS    00 MIN.
BLOCKS TRANSMITTED           :                             0
RETRANSMITS                  :                             0
BLOCKS RECEIVED              :                             0
RECEIVE BLOCK ERRORS         :                             0
LINK ALARMS                  :                             0
REMOTE DOWNS                 :                             0
RECEIVE FLOW CONTROL TIME    :          00 HRS     00 MIN   00 SEC.
AUTOMATIC REPORTING          :          OFF        9600     BAUD
```

Comparing the number of blocks transmitted with the number of retransmits needed to get the data through can indicate a line problem. Comparing the blocks received and receive block errors indicates the same problem from the other end of the link. The comparative numbers that you might encounter could be 10,000 blocks transmitted (or received) with 500 or 1000 retransmits (or receive block errors).

Link Alarms simply tell you that there are some sort of problems on the link. You will find that the Link Alarm numbers will correspond to the Retransmit and Receive Block numbers. Specifically, a Link Alarm means that it has been 10 seconds since the MultiMux has received an acknowledgment. Normally three acknowledgments will be received during a 10 second period.

The Remote Down entry means that a MultiMux has sent data 30 times and could not get it through (the link has been broken).

The other entries in the composite status report do not apply to link problems.

7.3   Test Cables

If you are using the MultiMux internal composite link modem, there are two test cables provided which can be used to help checkout your system (refer to Figure 7-1). The MultiMux Test cable is a special back-to-back composite link test cable that can connect your two MultiMux locally before installing them using a phone line. This cable will allow you to verify operation of all aspects of the MultiMux prior to actual installation. The second test cable is the Composite Link Loopback cable. Its function is to loopback the modem's signal to itself (analog loopback) so that you can check the function of the MultiMux while installed without having to use the composite link phone line. If you are using an external synchronous modem for link communications, refer to its documentation for testing procedures.

If you have any problems in performing these procedures, contact the Tech Support department for assistance, refer to Chapter 8.

Using the Test Cable

	Test Cable	
MultiMux		MultiMux

Internal Composite Connector

Note: Used locally before installation to verify operation of entire system except compolsite link.

Using the Composite Link Loopback Cable

Internal Composite Connector

MultiMux	Composite Link Loopback Cable	MultiMux

Note: Initiate Downline Load must be off for loopback testing.
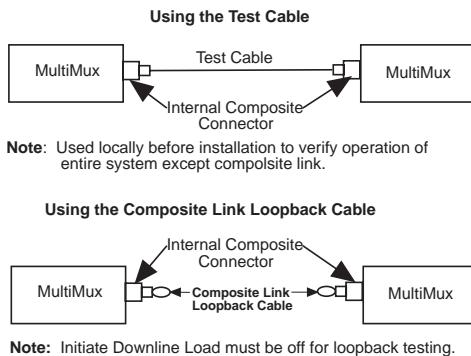
Figure 7-1 Off Line Test Modes

7.4   Troubleshooting Guide

The following guide is set up as a series of possible conditions, causes and suggested fixes or steps in finding the failing unit. Because of the different manufacturer's equipment involved in typical multiplexer networks, you may encounter "finger pointing" as to who is at fault. Who is at fault is not as important as getting you back on line as soon as possible. The intent of the following guide is to indicate the most probable cause of specific error conditions, but, since similar conditions may account for a number of different failures, the following guide is just that: a guide to troubleshooting.

The parts of your mux network are:

- Channel devices (printers, terminals, pc's, etc.)

- Channel Communications (RS232 cabling,synchronous modems, etc.)

- MultiMux control units

- Synchronous link modems (internal Multi-Tech or external)

- Composite link communications line (2-wire or 4-wire leased line with internal or external modems)

- Dial-up composite link communications line with internal or external modem

- Digital composite link communications line with internal or external DSU

Once you have found the probable cause of your problem, refer to the specific manual chapter for additional help or contact our Technical Support, refer to Chapter 8.

Table 7-1. Troubleshooting Guide

The following symptoms are typical of problems you might encounter:

- Supervisory Console not communicating with mux command port

- Supervisory Console not communicating with command modem

- Garbage on Supervisory console screen

- Composite Link down with CTS, XMT and REMOTE DWN LEDs ON

- Composite Link down with CO, CTS, XMT and RCV LEDs ON and REMOTE DWN LED ON

- Composite link down with CO CTS and REMOTE DWN LEDs ON

- Composite link and all channels down with REMOTE DWN and all channel RCV LEDs ON

- Flashing LINK ALARM LED

- All channel devices not communicating with mux, composite link up with CO, CTS,XMT and RCV LEDs ON and REMOTE DWN OFF

- Some channel devices not communicating with MultiMux and composite link up

- Channel device losing data

Note: If you continue to have difficulty after applying the solutions to these problems (found on pages 123-126), contact Technical Support for assistance, refer to Chapter 8.

Supervisory Console not communicating with mux command port

Problem	Communications softwarenot installed on Supervisory Console
Solution	1. Install communications software on supervisory console, refer to communicaitons software user's manual for installation.
Problem	Bad cable or cable connection
Solution	1. Check RS 232 cable connections between supervisory console and COMMAND PORT on MultiMux for loose connection or bent pins, refer to Supervisory Console Installation procedures in Chapter 4.
	2. Check RS232 cable connections between supervisosry console and COMMAND PORT on MultiMux for correct cable wiring, refer to Cable Diagrams in Appendix C.

Supervisory Console not communicating with command modem

Problem	Incorrect command modem baud rate
Solution	1. Verify command modem baud rate is set to 2400 bps, refer to communications software user's manual.

Garbage on Supervisory Console screen

Problem	Incorrect session parameters
Solution	1. Verify session parameters (data bits of 8, parity none, 1 stop bit), refer to communications software user's manual for parameter settings.

Composiste link down with CTS, XMT and REMOTE DWN LEDs ON

Problem	Composite Link cabling
Solution	1. If internal composite link modem is installed, check Composite Link cabling for loose connection.
	2. If external composite link modem is installed, check composite link cable for loose connection or bent pin.
Problem	Not receiving data from remote mux
Solution	1. Verify that both muxes are powered ON.
	2. Verify that both muxes are connected to communications line.
	3. If external modems are used, verify that they are powered ON and connected to the communication line and Mux composite link.
Problem	Faulty Communication line
Solution	1. Call phone company and veriy communicaiton line

Composite Link down with CO, CTS, XMT and RCV LEDs ON and REMOTE DWN LED ON

Problem	Both muxes set up for down line loading.
Solution	1. Remove front cover of both muxes and verify if DIP-Switch 1 is in the UP (ON) position.
	2. Place DIP-Switch 1 on one of the muxes in the DOWN (OFF) position.
Problem	Internal modem speeds on local and remote muxes do not match.
Solution	1. Verify internal modem's speeds with **$L** command.

Composite link down with CO CTS and REMOTE DWN LEDs ON

Problem   External modem settings on remote mux

Solution   1. Verify that external modem is set for sync, full duplex and internal clocking.

2. Connect composite link cable between mux and modem.

Composite link and all channels down with REMOTE DWN and all channel RCV LEDs ON

Problem   Mux memory failure

Solution   1. Enter L and recore all channel parameters before running memory test. Perform test by entering **&T2** command. All stored parameters will be destroyed.

2. Reconfigure all channel parameters.

Flashing LINK ALARM LED

Problem   High error rate on communication line

Solution   1. View composite link statistics using **#S0** command.

2. Perform local and remote loopback test, refer to the Local and Communications Line Testing in this chapter.

3. Call phone company and verify communication line.

All channel devices not communicating with mux, composite link up with CO, CTS,XMT and RCV LEDs ON and REMOTE DWN OFF

Problem	Incorrect channel parameter settings
Solution	1. Verify channel parameter settings for all channels, refer to Chapter 4 for the **CO** command.
	2. Change channel paramters to match channel devices. Refer to Chapter 4 for Channel Paramter Commands.
	3. perform channel device testing, refer to Channel Device Testing in this chapter.
Problem	Channel devices incorrectly cabled
Solution	1. Refer to cabling diagrams of both mux and channel devices.

Some channel devices not communicating with MultiMux and composite link up

Problem	Incorrect channel parameter settings fo rthose channel devices
Solution	1. Verify channel parameter settings for those channel devices, refer to **Lx** command in Chapter 4 to display channel parameters.
	2. Perform channel device testing, refer to Channel Device Testing in this Chapter.
Problem	Channel devices incorrectly cabled
Solution	1. Refer to cabling diagrams of both mux and channel devices.

Channel device losing data

Problem	Flow control not properly set
Solution	1. Verify flow control operations for the selected channel device, refer to **F0-F2** and **F5-F6** commands in Chapter 4.

7.5   Channel Device Testing

The first step in system testing is to check the operation of the multiplexer network section from each channel device to the MultiMux and back again to the channel device. These procedures will enable you to see that data from the channel device is passing through the MultiMux properly by echoing channel keystrokes through the MultiMux and then displaying them as correct characters on the channel device's monitor.

Table 7-2. Channel Device Testing Procedure

Note: This procedure will result in the echoing of data entered on each channel device keyboard to its respective monitor.

Step   Procedure

1   Place the local MultiMux unit in Test Mode 4* (i.e., executing the Analog Loop test) by entering the following command. If using external modem this test does not apply.

AT&T4 (hit Return)

The supervisory console will display the following message:

ANALOG LOOP - TEST #4

2   Enter data on the keyboard of each channel device and, if the local portion of your network is operating correctly, the data will be correctly displayed on each channel device monitor.

If the channel device is equipped with a local echo feature that is active, or if Echoplex is turned on for that channel, double characters will be displayed indicating that the MultiMux is correctly echoing data.

3   When you have verified that the channel devices are operating correctly, enter the following to end the test:

ATZ   (hit Return)

or

AT&TO (hit Return)

Note: The MultiMux must have downline loading turned off when doing channel device testing.

7.6 Local Modem and Communications Line Testing

After determining that the channel-device-to-MultiMux portion of the multiplexer network is operating properly, the next steps are to check the operation of the local modem, the communications line and the remote modem. By performing the procedures in Table 7-3, the MultiMux can send data (keystrokes) from the channel device and have the data echoed through the composite link and remote modem back to the channel device's monitor.

The procedures shown are generalized in that they apply to testing both the analog and digital segments of the remote modem. The following table shows the setting of the two modems to test the two network segments.

Table 7-3. Modems and Communications Line Testing Procedure

Step	Procedure
1	If external modems are used, set them to test the desired network segment according to the Figure 7-1. Refer to the modem documentation for proper test procedures.
2	If internal MultiMux modems are used, place them in the proper mode by executing the appropriate test mode (refer to Figure 7-1) by having the operator at the other end of your network enter the following on his or her supervisory console:

>   AT&x (hit Return)

x equals T5 for Digital Loop, T6 for Remote Analog Loop.

Testing Segment Setting	Local Modem Setting	Remote Modem
Communications Line and Remote Analog Circuitry	Normal Mode	Remote Analog Loop
Communications Line and Remote Digital Circuitry	Normal Mode	Digital Loop

Table 7-3.   Modems and Communications Line Testing Procedure (cont.)

3   Place your local MultiMux in normal operating mode by shutting power off and turning it back on. Make sure your 8-position DIP switch SW1 is in the off (closed) position.

4   With the two MultiMuxes in your network set properly, you can now enter data on the keyboard of each channel device and, if the network is operating correctly, the data will be correctly displayed on the channel device monitor. If the channel device is equipped with an active local echo feature, double characters will be displayed.

5   When you have verified that the communications line and modems are working correctly, have the operator at the other end of your network place the MultiMux in normal operating mode by reversing step 1 (if necessary) and shutting power off then on to the unit.

7.7 MultiMux Functional Testing Procedures

There are tests available on the MultiMux which check various functions within the MultiMux logic. These tests will assist you in trouble shooting problems which are not related to the composite communications channel or local channel devices. The two tests described below will check the non-volatile memory used for parameter storage and internal circuitry, called the Watch-Dog circuitry, which is responsible for keeping the MultiMux functioning normally.

Table 7-4. MultiMux Functional Testing Pocedures

Note: Executing the Battery/Memory test procedure will result in the destruction of stored parameters.

Step   Procedure

1   Before checking the non-volatile memory feature, enter an **ATL** command and record all channel parameters.

2   Place the MultiMux in Test mode 8 (i.e., executing the non-volatile Memory test) by entering the following command:

        AT&T8 (hit Return)

        (let the test complete its cycle)

The supervisory console will display the following message:

Memory test - This test will destroy all stored onfigurations.

Do you wish to continue? (Y/N)

3   Press the Y key (the message "writing" will appear while the test is running) and the following message will be displayed on the supervisory console:

Turn power off for 10 seconds and then back on.
Then enter AT to end test.

4   As the message indicates, turn power off for ten seconds and then back on. Depending on the condition of the memory, one of the following messages will appear on your supervisory console:

Non-Volatile Memory Test Passed

or

Non-Volatile Memory Test Failed

Enter the following: AT (hit Return)

5   To check the Watch-Dog circuitry, place the local MultiMux unit in Test Mode 9 (i.e., executing the Watch-Dog Timer Test) by entering the following command:

AT&T9   (hit Return)

The supervisory console will display the following message:

Watch-Dog Timer Test #9 - wait for test indicator to turn off and when the test indicator comes back on, enter "AT" to end test.

6   As the message indicates, after the test indicator comes back on enter the following:

AT   (hit Return)

If the test passes, the following message will be displayed:

WATCH DOG TEST PASSED

MultiMux

Chapter 8- Service, Warranty, & Technical Support

MultiTech Systems

8.1   Introduction

This chapter starts out with statements about your MultiMux 2-year warranty. The next section, Tech Support, should be read carefully if you have questions or problems with your MultiMux. It includes the technical support telephone numbers, space for recording your product information, and an explanation of how to send in your MultiMux should you require service. The final three sections explain how to use our bulletin board service (BBS), and get support through CompuServe and the Internet.

8.2   Limited Warranty

Multi-Tech Systems, Inc. ("MTS") warrants that its products will be free from defects in material or workmanship for a period of two years from the date of purchase, or if proof of purchase is not provided, two years from date of shipment. MTS MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by the customer or any party without MTS's written authorization, or used in any manner inconsistent with MTS's instructions.

MTS's entire obligation under this warranty shall be limited (at MTS's option) to repair or replacement of any products which prove to be defective within the warranty period, or, at MTS's option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS's factory transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PURCHASE PRICE FOR DEFECTIVE PRODUCTS.

8.3   Tech Support

Multi-Tech has an excellent staff of technical support personnel available to help you get the most out of your Multi-Tech product. If you have any questions about the operation of this unit, call 1-800-972-2439. Please fill out the MultiMux information (below), and have it available when you call. If your MultiMux requires service, the tech support specialist will guide you on how to send in your MultiMux (refer Section 8.3.2).

8.3.1   Recording MultiMux Information

Please fill in the following information on your Multi-Tech MultiMux. This will help tech support in answering your questions. (The same information is requested on the Warranty Registration Card.)

   Model No.:

    Serial No.:

    Firmware Version:

The model and serial numbers are on the bottom of your MultiMux. Type **ATI1** to display the PROM firmware version number.

Please note if a channel board, internal modem or DSU has been added to your MultiMux before calling tech support. Also, note the status of your MultiMux including LED indicators, screen messages, diagnostic test results, parameter listing (**ATL**), DIP-Switch settings, problems with a specific application, etc. Use the space below to note the MultiMux status:

_____
_____
_____
_____
_____
_____
_____
_____

8.3.2   Service

If your tech support specialist decides that service is required, your MultiMux may be sent (freight prepaid) to our factory. Return shipping charges will be paid by Multi-Tech Systems.

Include the following with your MultiMux:

- a description of the problem.

- return billing and return shipping addresses.

- contact name and phone number.

- check or purchase order number for payment if the MultiMux is out of warranty. (Check with your technical support specialist for the standard repair charge for your MultiMux).

- if possible, note the name of the technical support specialist with whom you spoke. If you need to inquire about the status of the returned product, be prepared to provide the **serial number** of the product sent (see Section 8.3.1).

Send modems to this address:

MULTI-TECH SYSTEMS, INC.

2205 WOODALE DRIVE

MOUNDS VIEW, MINNESOTA 55112

ATTN: SERVICE OR REPAIRS

You should also check with the supplier of your MultiMux on the availability of local service and/or loaner units in your part of the country.

8.4   About the Multi-Tech BBS

Multi-Tech Systems maintains a Bulletin Board Service (BBS) for its customers. The information available via the BBS includes: new product information, product upgrade data, problem solving tips, and a message service for you to leave questions for which you would like additional information. The phone number for the Multi-Tech BBS is (612) 785-3702 or (800) 392-2432 (U.S.A. and Canada).

The BBS can be accessed by any asynchronous modem operating at speeds of 28,800-1200 bps with a setting of word length of 8 bits, 1 stop bit, and no parity.

8.4.1   Logging on to the Multi-Tech BBS

To log on to the Multi-Tech BBS, perform the following steps.

1. Set your communications program to 8-N-1.

2. Dial our BBS at (800) 392-2432 (USA and Canada) or (612) 785-3702 (international and local).

3. At the prompts, type your first name, last name, and password; then press RETURN. If you are a first time caller, the BBS will ask if your name is spelled correctly. If you answer yes, a questionnaire will appear. You must complete the questionnaire to use the BBS on your first call.

4. Press RETURN until the Main Menu appears. From the Main Menu you have access to three main areas: the Files Menu, the Message Menu, and Bulletins. For help on menu commands, type ?.

8.4.2 Downloading a File

If you know the file name

1. From the Main Menu, type **F** to access the Files Menu, then type **D**.
2. Enter the name of the file you wish to download from the BBS.
3. If a password is required, enter the password.
4. Answer **Y** or **N** to the automatic logoff question.
5. Select a file transfer protocol by typing the indicated letter, such as **Z** for Zmodem (the recommended protocol).
6. If you select Zmodem, the transfer will begin automatically. If you select another protocol, you may have to initiate the transfer yourself. (In most datacomm programs, the PAGE DOWN key initiates the download.)

If you don't know the file name

1. From the Main Menu, type **F** to access the Files Menu. For a list of file areas, type **L** twice. (If you do not type the second *L*, you will list all of the files on the BBS.)
2. Mark the file areas you would like to examine by typing each file area's list number and a RETURN.
3. Enter **L** to list all the files in the selected file areas. Enter **C** to go forward in the file list and **P** to go back.
4. Mark one or more files for download by entering **M**, the list numbers of the files, and a RETURN.
5. Enter **D**. You will see a list of the files you have marked. Enter **E** if you would like to edit the list; otherwise enter **D** again to start the download process.
6. Select a file transfer protocol by typing the indicated letter, such as **Z** for Zmodem (the recommended protocol).
7. If you select Zmodem, the file will transfer automatically. If you select another protocol, you may have to initiate the transfer yourself. (In MEWTERM and many other communications programs, the PAGE DOWN key initiates the download.)
8. When the download is complete, enter **S** to return to the File Menu.

8.4.3   Reading a Message

When you log on, the BBS will tell you if you have a personal message (mail). At the prompt *Would you like to read it now?,* type **R** to read the message. This is the only point at which you can read your mail, since you cannot read any messages from the Message Menu.

8.4.4   Leaving a Message

The Multi-Tech BBS has no public discussion areas. To leave a personal message, select the Message Menu by typing **M** at the Main Menu. Type **E**, then press RETURN to select the Sysop conference. Enter the name of the recipient (or "Sysop"), the subject, and the message text. Press ESCAPE to finish, then type **S** to save the message and exit. To abort the message at any point, leave any of the fields blank and press RETURN.

8.4.5   Bulletins

When you log on, the BBS will ask if you would like to view the bulletin menu. The bulletins are menu-driven; to read a bulletin, enter its number. You can also access the bulletins by typing **B** at the Main Menu.

8.5   About the Internet

Multi-Tech is a commercial provider on the Internet. Multi-Tech's presence includes a Web site at:

http://www.multitech.com

and an ftp site at:

ftp://ftp.multitech.com

The ftp server mirrors the Multi-Tech BBS.

MultiMux

Appendices

MultiTech Systems

Appendix A

ASCII Character Code/Hex/Decimal Conversion Chart

CTRL	CODE	HEX	DEC	CODE	HEX	DEC	CODE	HEX	DEC	CODE	HEX	DEC
@	NUL	00	0	SP	20	32	@	40	64		60	96
A	SOH	01	1	!	21	33	A	41	65	a	61	97
B	STX	02	2	"	22	34	B	42	66	b	62	98
C	ETX	03	3	#	23	35	C	43	67	c	63	99
D	EOT	04	4	$	24	36	D	44	68	d	64	100
E	ENQ	05	5	%	25	37	E	45	69	e	65	101
F	ACK	06	6	&	26	38	F	46	70	f	66	102
G	BEL	07	7	'	27	39	G	47	71	g	67	103
H	BS	08	8	(	28	40	H	48	72	h	68	104
I	HT	09	9	)	29	41	I	49	73	i	69	105
J	LF	0A	10	*	2A	42	J	4A	74	j	6A	106
K	VT	0B	11	=	2B	43	K	4B	75	k	6B	107
L	FF	0C	12	,	2C	44	L	4C	76	l	6C	108
M	CR	0D	13	-	2D	45	M	4D	77	m	6D	109
N	SO	0E	14	.	2E	46	N	4E	78	n	6E	110
O	SI	0F	15	/	2F	47	O	4F	79	o	6F	111
P	DLE	10	16	0	30	48	P	50	80	p	70	112
Q	DC1	11	17	1	31	49	Q	51	81	q	71	113
R	DC2	12	18	2	32	50	R	52	82	r	72	114
S	DC3	13	19	3	33	51	S	53	83	s	73	115
T	DC4	14	20	4	34	52	T	54	84	t	74	116
U	NAK	15	21	5	35	53	U	55	85	u	75	117
V	SYN	16	22	6	36	54	V	56	86	v	76	118
W	ETB	17	23	7	37	55	W	57	87	w	77	119
X	CAN	18	24	8	38	56	X	58	88	x	78	120
Y	EM	19	25	9	39	57	Y	59	89	y	79	121
Z	SUB	1A	26	:	3A	58	Z	5A	90	z	7A	122
[	ESC	1B	27	;	3B	59	[	5B	91	{	7B	123
\	FS	1C	28	<	3C	60	\	5C	92			7C	124
]	GS	1D	29	=	3D	61	]	5D	93	}	7D	125
—	RS	1E	30	>	3E	62	^	5E	94	–	7E	126
—	US	1F	31	?	3F	63	_	5F	95	DEL	7F	127

NUL	Null, or all zeros	DC1	Device Control 1	SI	Shift In
SOH	Start of Header	DC2	Device Control 2	SO	Shift Out
STX	Start of Text	DC3	Device Control 3	SYN	Sync.
ETX	End of Text	DC4	Device Control 4	LF	Line Feed
EOT	End of Transmission	CAN	Cancel	FF	Form Feed
ACK	Acknowledge	EM	End of Medium	ENQ	Enquiry
BEL	Bell or Alarm	SUB	Substitute	ESC	Escape
BS	Backspace	FS	File Separator	DLE	Data Link Escape
HT	Horizontal Tab	GS	Group Separator	NAK	Negative Acknowledge
VT	Vertical Tab	RS	Record Separator	CR	Carriage Return
ETB	End Transmission Block	DEL	Delete		

Appendix B

RS232C Interface Specification

The MultiMux RS232C interface circuits have been designed to meet the electrical specifications given in the EIA (Electronic Industries Association) RS232C and CCITT (Consultative Committee of International Telegraph and Telephone) standards. All signals generated by the mux are approximately 10 volts when measured across a load of 300 ohms or greater. The receiving circuits of the mux will accept signals in the 3 to 25 volt range. The voltage thresholds are:

Negative   =voltage more negative than -3 volts with respect to signal ground.
Positive   =voltage more positive than +3 volts with respect to signal ground.

SIGNAL INFORMATION:	NEGATIVE	POSITIVE
Binary State	One	Zero
Signal Condition	Mark	Space
Control and Timing Function	Off	On

The input impedances of all mux circuits which accept signals from the data processing terminal or CPU equipment have DC resistances of 4.7K. For more specific details, consult the EIA RS232C standard itself.

The following chart lists the EIA RS232C interface pins and circuits present on the mux RS232C interface connector. All other pins are unused. The composite side of the mux is configured as a DTE device and the channel sides are DCE devices.

MMH900 Series Statistical Multiplexer

PIN ASSIGNMENT	MULTI-TECH DESIGNATION	EIA CIRCUIT	CCITT CIRCUIT	SIGNAL SOURCE*	CIRCUIT FUNCTION
2	SD	BA	103	DTE	Transmitted Data
3	RD	BB	104	DCE	Received Data
4	RTS	CA	105	DTE	Request to Send
5	CTS	CB	106	DCE	Clear to Send
6	DSR	CC	107	DCE	Data Set Ready
7	SG	AB	102	——	Signal Ground
B	CD	CF	109	DCE	Data Carrier detector
9	+V	+V	--	DCE	Test Voltage
15	TC	DB	114	DCE	Transmit Clock
17	RC	DD	115	DCE	Receive Clock
20	TR	CD	108/2	DTE	Data Terminal Ready
22	RI	CE	125	DCE	Ring Indicator
24	XTC	DA	113	DTE	External Transmit
25	OOS	CN	142	DTE	Terminal Busy

*DTE = Data Terminal Equipment
 DCE =Data Communications Equipment

The computer or terminal should be supplied with a cable terminated with a Cinch DB25P (or equivalent) connector mounted in a Cinch DB51226-1 (or equivalent) hood assembly as specified by the RS232C/V.24 standard.

Appendix C

Cabling Diagrams

Channel Cables

DCE to Channel cabling (with EIA pass Thru)

PIN NO.   PIN NO.

To
MultiMux
Channel
Connector

1	1	CHASSIS GROUND (AA)
2	2	TRANSMIT DATA (BA)
3	3	RECEIVE DATA (BB)
4	4	REQUEST TO SEND (CA)
5	5	CLEAR TO SEND (CB)
6	6	DATA SET READY (CC)
7	7	SIGNAL GROUND (AB)
8	8	CARRIER DETECT (CF)
20	20	DATA TERMINAL READY (CD)
22	22	RING INDICATOR (CE)
25	25	OUT OF SERVICE/BUSY
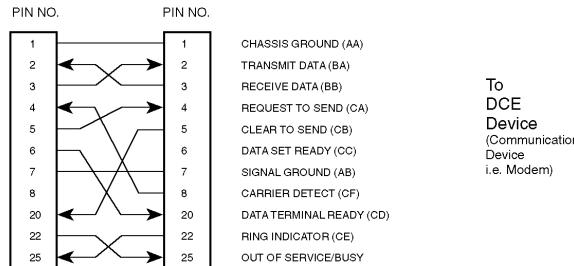
To
DCE
Device
(Communication
Device
i.e. Modem)

DCE to Channel cabling (without EIA pass Thru)

PIN NO.   PIN NO.

To
MultiMux
Channel
Connector

1	1	CHASSIS GROUND (AA)
2	2	TRANSMIT DATA (BA)
3	3	RECEIVE DATA (BB)
4	4	REQUEST TO SEND (CA)
5	5	CLEAR TO SEND (CB)
6	6	DATA SET READY (CC)
7	7	SIGNAL GROUND (AB)
8	8	CARRIER DETECT (CF)
20	20	DATA TERMINAL READY (CD)
22	22	RING INDICATOR (CE)
25	25	OUT OF SERVICE/BUSY
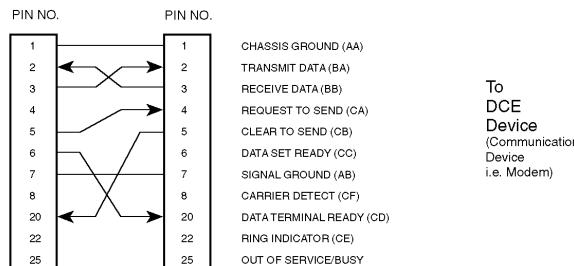
To
DCE
Device
(Communication
Device
i.e. Modem)

DTE to Channel cabling
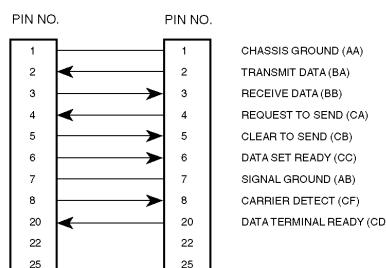
PIN NO.   PIN NO.

To
MultiMux
Channel
Connector

1	1	CHASSIS GROUND (AA)
2	2	TRANSMIT DATA (BA)
3	3	RECEIVE DATA (BB)
4	4	REQUEST TO SEND (CA)
5	5	CLEAR TO SEND (CB)
6	6	DATA SET READY (CC)
7	7	SIGNAL GROUND (AB)
8	8	CARRIER DETECT (CF)
20	20	DATA TERMINAL READY (CD)
22	22	
25	25	

To
DTE
Device
(Terminal
Device
i.e. ASCII
Terminal)

Command Port Cables

DCE to DTE cabling

PIN NO.   PIN NO.

Pin		Signal
1	1	CHASSIS GROUND (AA)
2	2	TRANSMIT DATA (BA)
3	3	RECEIVE DATA (BB)
4	4	
5	5	CLEAR TO SEND (CB)
6	6	DATA SET READY (CC)
7	7	SIGNAL GROUND (AB)
8	8	CARRIER DETECT (CF)
20	20	DATA TERMINAL READY (CD)
22	22	
25	25	

To MultiMux Command Port Connector

To DTE Device (Terminal Device i.e. ASCII Terminal)

DCE to DCE cabling

PIN NO.   PIN NO.

Pin		Signal
1	1	CHASSIS GROUND (AA)
2	2	TRANSMIT DATA (BA)
3	3	RECEIVE DATA (BB)
4	4	
5	5	
6	6	DATA SET READY (CC)
7	7	SIGNAL GROUND (AB)
8	8	
20	20	DATA TERMINAL READY (CD)
22	22	
25	25	

To MultiMux Command Port Connector

To DCE Device (Communication Device i.e. Modem)
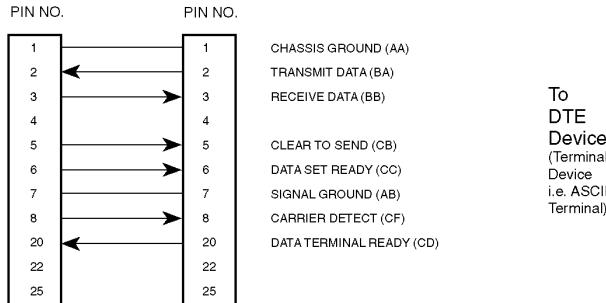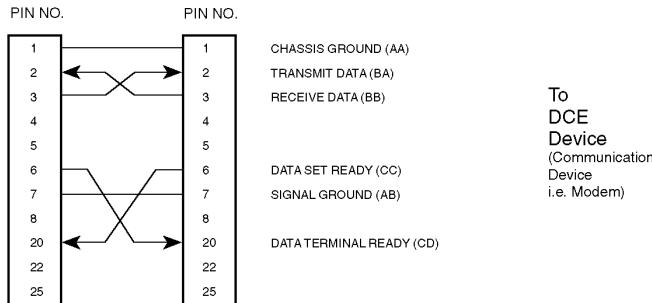
Composite Link Cabling

RS232C/V.24 *Configured Composite Link

```
        PIN NO.        PIN NO.
                                    CHASSIS GROUND (AA)
          1              1
          2              2          TRANSMIT DATA (BA)
          3              3          RECEIVE DATA (BB)
To        4              4          REQUEST TO SEND (CA)              To
External  5              5          CLEAR TO SEND (CB)               MultiMux
Synchronous                                                          External
Modem/DSU 7              7          SIGNAL GROUND (AB)               Modem/DSU
Connector 8              8          CARRIER DETECT (CF)              Connector
          15             15         TRANSMIT CLOCK (DB)
          17             17         RECEIVE CLOCK (DD)
          20             20         DATA TERMINAL READY (CD)
          25             25
```
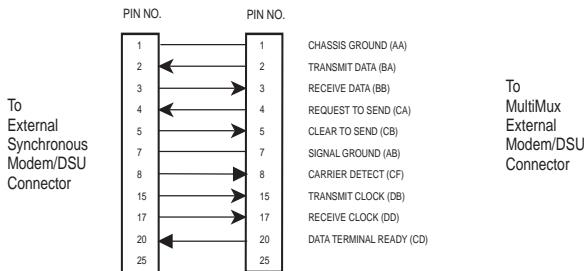
V.35 Adapter Cable Configured on a RS232C/V.35** Composite Link

```
V.35 34-PIN              25-PIN
CONNECTOR (MALE)     CONNECTOR (FEMALE)

    A                    1       PROTECTIVE GROUND
    B                    7       SIGNAL GROUND
    C                    4       REQUEST TO SEND
    D                    5       CLEAR TO SEND
    E                    6       DATA SET READY
    F                    8       DATA CARRIER DETECT
    H                    20      DATA TERMINAL READY
    P                    2       TRANSMIT DATA A
    R                    3       RECEIVE DATA A
    S                    12      TRANSMIT DATA B
    T                    22      RECEIVE DATA B
    U                    23      EXTERNAL TX CLOCK A
    V                    17      RECEIVE CLOCK A
    W                    25      EXTERNAL TX CLOCK B
    X                    18      RECEIVE CLOCK B
    Y                    15      TRANSMIT CLOCK A
    a                    21      TRANSMIT CLOCK B
```

* The MultiMux RS232C interface circuits have been designed to meet the electrical specificaitons given in EIA (Electronic Industries Association RS232C and CCITT (Consultative Committee International Telegraph and Telephone) V.24 Stanards.

** When configured for V.35 interface operation on composite link A or B, the V.35 adapter cable should be used. This cable uses a 25-pin female connector at one end and a 34-pin winchester male connector at the other end.

RJ45 Cabling for Internal DSU
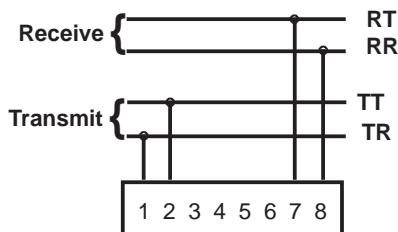
Back to Back Mux Cable*

25-PIN CONNECTOR (FEMALE)				25-PIN CONNECTOR (FEMALE)
FG	1		1	FG
TD	2		3	RD
RD	3		2	TD
RTS	4		5	CTS
CTS	5		4	RTS
SG	7		7	SG
DSR	6		20	DTR
DCD	8			
TXC	15		24	INT. CLK
RXC	17			
DTR	20		6	DSR
			8	DCD
INT. CLK	24		15	TXC
			17	RXC
"DCE"				"DTE"
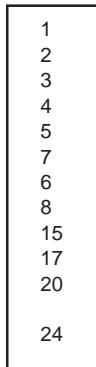
* This cable is used to connect two muxes back to back during testing. The cable is asymmetrical and allows one of the mux's to provide clock to the TxC and RxC pins of the other mux. Make sure the configuration of the composite link includes one of them as having an internal clock and the other mux an external clock. The Mux Back-to-Back (**$MUXB**) command is used during this testing process.

Appendix D
Command Modem Commands

Command	Description

A   **Answer**

The Answer Mode forces the command modem into answer mode. Entering **ATA** when in the Command mode will immediately bring the command modem off-hook, out of the command mode and into the On-Line Answer mode, and cause it to retransmit its carrier signal over the phone line. If no responding carrier tone is received within thirty seconds (or some other time as determined by S-Register S7), the command modem will cease transmitting its tone, hang up, and go back into Command mode.

A/   **Repeat Last Command**

The Repeat Last Command command causes the command modem to repeat the last command that was executed. The last command will remain stored in the modem's command buffer until the Attention command (AT) is entered. Therefore AT must not be entered before an **A/** command because the **A/** will have no effect if an AT command already cleared the previous command out of the command buffer.

B   **Bell or CCITT Answer Tone**

The **B** command is used to select the frequency that the command modem uses for its answer tone. The answer tone is the tone transmitted by a command modem receiving a call; this initiates the handshaking between the two command modems. At 2400 bps there is no conflict, because all command modems use CCITT frequencies. At the lower speeds (0-1200 bps), in the U.S., some modems use the Bell frequency of 2225 Hz. However, the CCITT specification for V.22 has an answer tone frequency of 2100 Hz.

D   **Dial**

The letter D in a command will cause the command modem to dial the telephone number immediately following it. For example, if you enter **ATD5551212** and hit Return, the command modem will dial the number 555-1212.

Valid dial characters are 0 through 9, A through D, #, and *. Dial modifiers are: , P R S=x T W ; @ and !. In pulse dialing, non- digit characters have no meaning.

The Dial command can also be used in conjunction with a telephone set for manual dialing. You would dial the number on your telephone set, and after hearing the high-pitched answer tone on your handset, you would enter **ATD** on your keyboard and hit Return. You would then hang up the handset. Unless you have a specific need to dial in this manner, we recommend you use the first method, where the telephone number is entered on your keyboard.

E0-1   **Echo Command Mode Characters**

If the command modem is connected to a full duplex terminal or computer, it will be necessary for the modem to be configured to echo back characters entered while in the command mode in order for them to be displayed. The **E** command is used to configure the Command mode echo, with **ATE0** disabling the echo and **ATE1** enabling the echo.

If neither method is selected, the factory default will cause the modem to echo the command characters.

&F   **Load Command Modem Factory Defaults**

The Load Command Modem Factory Default **&F** Command resets the S-Registers and command modem commands to thefactory default values. They are as follows:

S-Registers: S0=0, S1=0, S2=43, S3=13, S4=10, S5=8, S6=2, S7=30, S8=2, S9=6, S10=14,S11=95, S12=50, S18=0, S25=5, S26=1, and S28=0.

Commands:

Command	Name	Default
B1	Answer Tone:	Bell
E1	Echo:	Enabled
P	Dialing:	Pulse
Q0	Result Codes:	Enabled
V1	Result Codes:	Word
X4	Result Code Set/ Call Progress:	Dial Tone & Busy

H0-1   **Hanging Up, and Bringing thePhone Line Off Hook**

You can make the command modem hang up (go On Hook), or go Off Hook, with the **H** command. Entering **ATH1** (upper case) will bring the line Off Hook just as if you had picked up the telephone handset. The command modem remains in command mode.

You can hang up by entering **ATH0** or **ATH** (remember that the default value is 0 when nothing is entered). It is not necessary to use the **H1 command** to bring the line Off Hook when using the command modem D command to dial, since the modem will go off hook automatically when you hit Return at the end of the Dial command.

I	**Inquiry for Product Code**

Some systems or software packages may automatically check the "identification" of the modem with which they are communicating, by using the **I** command. This "read" command enables the software to determine the type of modem with which it is communicating.

When **ATI** or **ATI0** (upper case) is entered, the command modem will respond with xxx, with the first two digits indicating model, and the third digit indicating the revision level.

O	**Exiting Command Mode, Going Back On-Line**

You can bring the command modem out of command mode back into the On-Line Mode, by entering **ATO** (where O is the letter O, not the number 0). In this case, the **O** command reverses what was done by entering the Escape code (see Escape Code +++ explanation).

P, T   **Pulse or Tone Dialing**

The command modem will dial numbers using either pulse or tone dialing, or in a combination of both methods. Pulse dialing is the method used by rotary-dial telephones, which involve the timed opening and closing of a line relay. Tone dialing is that used by push button Touch-Tone telephones, and is sometimes referred to as DTMF, or Dual-Tone Multi-Frequency dialing.

This is controlled by including a P for Pulse or a T for Tone in the dialing command, right before the digits you wish to have dialed in that manner.

For example, you would pulse-dial the number 555-212 by entering **ATDP5551212** and hitting Return. You could tone-dial the same number by entering **ATDT5551212** and hitting Return.

If neither Pulse or Tone dialing is specified in the dialing command, the command modem will use whatever method was last used. If the modem was reset or just powered up, it will use Pulse dialing, even if you do not use the letter P in your dial command.

Nearly all telephone systems in the U.S. are now compatible with tone dialing. Since that is the faster method, you will probably choose the tone method for your dialing.

An example of combining pulse and tone dialing could involve a PBX system where 9 had to be pulse-dialed first, then the rest of the number tone-dialed after pausing for a second dial tone. The number would be dialed by entering **ATDP9,T5551212** and hitting Return. (The comma causes a pause, which is explained later in this appendix.)

Q0-1	**Result CodesEnabled or Disabled**

It may be desirable to disable the Result Codes (see V command) altogether in certain applications, such as computer-controlled auto dialing. The **Q** command is used to do this, with **ATQ1** disabling the Result Code transmissions and **ATQ0** (or **ATQ)** enabling them. If you do not select either method, the factory default setting will enable the Result Codes to be sent.

R	**Forcing an Answer Tone in the Dialing**

If you wish to dial up another modem that is in the originate mode, it is necessary that your modem be in the Answer mode to initiate the "handshaking" and establishment of a connection. This is done automatically when the command letter **R** is entered at the end of a dialing command. When this is done, the command modem will switch to the Answer mode as soon as the number is dialed and transmit a carrier signal to the other modem.

For example, entering **ATD5551212R** and hitting Return would cause the number 555-1212 to be dialed and cause the command modem to transmit a carrier signal at the end of the dialing sequence.

Sn?

SN=xxx   **S-Register Read or Write**

The **S** command can be used to both assign a value to or read the current value of an S-Register. (Refer to Appendix G of this manual for the function of each S-Register.) The format for reading a register is to enter the letter S (upper case) followed by the register number and a question mark ? and then hit Return. For example, entering **ATS7?** and hitting Return will display the value of Register 7 in a 3 digit Decimal form. The number 30 would appear as 030, and the number 255 would appear as 255.

The format for assigning a value to a register is to enter the letter S followed by the register number followed by an equal sign, and then enter the new value in a decimal format. ASCII characters will have to be converted to their decimal equivalents before being entered. S-Register decimal values can range from 0 to 127 for ASCII characters, or from 0 to 255 for numeric values. A complete ASCII character Code-to-Decimal conversion chart is located in Appendix A.

For example, if you wish to have longer pauses caused by the comma in a dialing command, enter **ATS8=5** to assign 5 as the value for the S-Register S8 (meaning that the modem will pause five seconds for the comma in the dialing command instead of the normal two). Or, if you wish to configure the command modem to answer incoming calls after the 30th ring, instead of after the first ring, enter **ATS0=30** and hit Return to assign the value 30 to S-Register S0.

Once an S-Register is selected, it remains selected until another register is selected. The value of that S-Register can then be read by entering **AT?** and changed by entering **AT=** and the value.

| **Vo-1** | | **Result Codes Word or Digit** |

The command modem can display its Result Codes on your supervisory console. These codes can appear either in word("verbose") or single digit ("terse") form. For example, if after dialing, no carrier signal is detected, the result can be displayed either as NO CARRIER or as the digit 3. The **V** command is used to determine which method is used.

Entering **ATV0** will cause the command modem to display the Result Codes as digits, while **ATV1** will display them as words. If you do not select a method, the factory default setting will cause the command modem to use the verbose results.

The following shows the terse and verbose result codes and a description of each code.

Terse	Verbose	Description
0	OK	Your command was executed without errors.
1	CONNECT	A carrier signal has been detected 300 bps.
2	RING	A ring signal has been detected from an incoming call.
3	No Carrier	No Carrier signal has been detected, or the carrier signal was lost.
4	ERROR	An error is present in your command sequence, e.g. invalid characters or too many characters.
5	CONNECT	A carrier signal has been 1200 detected at 1200 bps.
10	Connect	A carrier signal has been detected at 2400 bps.
13	DATA	Command modem connected as data modem during auto answer.

You can also choose to completely eliminate the display of all of the Result Codes. This is accomplished by executing the **Q** command.

&V	**View Active Configuration and User Profiles** The View Active Configuration and User Profiles **&V** command displays the commands and S-Register settings along with the stored telephone numbers. A typical example of active and stored profiles and stored telephone numbers are as follows:

ACTIVE PROFILE:

B1 E1 H0 Q0 V1 X4 Y0 &G0 &P0 &T4 &Y

S00:000 S01:000 S02:043 S03:013 S04:010
S05:008 S06:002 S07:030 S08:002 S09:006
S10:014 S12:050 S14:AAH S16:00H S18:000

S21:00H S22:76H S23:07H S25:005
S26:001S027:40H S28:00H

STORED PROFILE 0:

B1 E1 H0 Q0 V1 X4 Y0 &G0 &P0 &T4

S00:000 S14:AAH S18:000 S21:00H S22:76H
S23:15H S25:005

S26:001S027:40H S28:00H

STORED PROFILE 1:

B1 E1 H0 Q0 V1 X4 Y0 &G0 &P0 &T4

S00:000 S14:AAH S18:000 S21:00H S22:76H
S23:17H S25:005

S26:001S027:40H S28:00H

TELEPHONE NUMBERS:

&Z0= 18009722439

&Z1= 6127859875

&Z2=

&Z3=

W	**Wait for Dial Tone**

The W command causes the command modem to wait up to a specified time for the dial tone to occur. The telephone number is dialed immediately upon dial tone detection. The S-Register S7 value determines the maximum wait time. If a busy signal is detected instead of dial tone, the command modem returns a BUSY result code and goes On-Hook, abandoning subsequent instructions on the command line. The factory default setting is 30 seconds

&W0-1	**Store Active Profile**

The Store Active Profile &W command writes the storable parameters of the active configuration to one of two profiles in NOVRAM. The current values of the following commands and registers are stored:

Commands: Bn, En, Qn, Vn, Xn, &Gn, &Pn, and &Yn

S-Registers: S0, S14, S18, S21, S22, S23, S25, S26, S27, and S28

The **&W0** command stores the active profile in the NOVRAM at location zero and **&W1** stores the active profile in location one. **&W0** is the factory default setting.

X	**Result Code Set/Call Progress**

Result Code Set/Call Progress

The Result Code Set/Call Progress **X** command selects which set of responses and dialing functions are active in Command mode. You can choose to have certain responses suppressed,such as the speed of the connection, and whether or not dial tone and busy signal are detected. You can choose either the basic result code set (i.e., the connect response with no speed indication of the called command modem) or the extended result code set (i.e., connection response with speed indication) and whether or not call progress is activated.

The **ATX0** and **ATX1** commands disable the call progress functions (dial tone and busy signal) and activates either the basic or extended result codes. This call progress method is referred to as dumb dialing where actual dial tones are not detected, instead the command modem relies on timed pauses. The **ATX0** enables the basic result codes while the **ATX1** enables the extended result codes with call progress disabled on both commands.

The **ATX2** through **ATX4** commands determine whether or not call progress is activated and extended result codes are enabled on each of these commands.

The **ATX2** command waits for a dial tone before dialing. The connect response and speed indication (e.g., CONNECT xxxx where as xxxx is the connect speed of 2400 bps) are enabled upon detection of a dial tone. Busy signal is not detected.

The **ATX3** command causes the command modem to dial blind (i.e., does not wait for dial tone) and enable a BUSY result code if a busy signal is detected. This feature is useful because it allows the command modem to immediately abandon a call rather than wait the thirty seconds for a carrier signal that will never come.

The **ATX4** command causes the command modem to wait for a dial tone before dialing. This command is referred to as the smart dialing method where as the **ATX3** command is referred to as blind dialing. The CONNECT xxxx result codes are activated and the BUSY result code is enabled if a busy signal is detected from the called command modem. The **ATX4** command is the factory default setting.

The Result Code Set/Call Progress X commands are summarized below.

ATX0   Basic result codes are enabled. Dumb dialing (dial tone and busy signal) capability is provided.

ATX1   Extended result codes are enabled. Dumb dialing capability is provided.

ATX2   Wait for dial tone before dialing is enabled. Extended result codes are enabled. Busy signal is not detected.

ATX3   Blind dialing is enabled along with extended result codes. Busy result code is enabled if the busy signal is detected.

ATX4   Smart dialing is enabled with extended result codes. Smart dialing provides dial tone and busy signal detection. **ATX4** is the factory default setting.

&Y0-1   **Select Stored Profile on Power UP**

The Select Stored Profile on Power Up (**&Y**) command determines which stored profile is established on power up or reset of the command modem. The **&Y0** command selects stored profile 0 and **&Y1** selects stored profile 1 on power up or reset. The profile is stored using the **&W** command. **&Y0** is the factory default setting.

Z0-1   **Recall Stored Profiles**

The **Z** command causes the command modem to retrieve the stored configuration from nonvolatile memory (NOVRAM) and store it in the active configuration area. The command mode buffer is cleared after the **Z** command is executed. The **ATZ0** command loads profile 0 into the active configuration area and **ATZ1** command loads profile 1. The active profiles are stored using the **&W** command and viewed using the **&V** command which are explained earlier in this section.

&Z0-3=x   **Store Telephone Number**

The Store Telephone Number (**&Z**) command causes the command modem to store up to four strings of telephone numbers into NOVRAM for later recall by the Dial Stored Number **ATDSx** command. The format for this command is **&Z** and up to a 36 character telephone number and/or dialing modifiers which are stored at location 0. If the command format is **&Z=** (=is a delimiter) with no number preceding the delimiter, this telephone number is also stored at location 0. If the format of this command is **&Zx=** where the number preceding the delimiter is between 0 and 3, the telephone number and/or dialing modifiers are stored at the location specified by the number preceding the delimiter.The following characters are allowed to be stored: 0 through 9, A through D, T P R W # * , ! ; along with the delimiter (=).

0 to 9, A to D,

 # and *   **Dial Digits/Characters**

Digits 0 through 9 and characters A through D, # and * are valid dial characters. Characters A through D, # and * represent specific tone pairs and therefore, can be used only when tone dialing.

@	**Wait for Quiet Answer**

The Wait for Quiet Answer (**@**) command causes the command modem to look for rings followed by 5 seconds of silence before processing the next symbol in the dial command. This command is used for accessing a system that does not provide a dial tone. S-Register #7 determines the maximum wait time. If Quiet Answer is detected, the dial modifiers following the command are executed. If busy is detected, the command modem returns a BUSY result code and goes to the hang-up process, aborting further execution of commands.

!	**Flash On Hook**

The Flash On Hook (**!**) command causes the command modem to go on hook for 0.75 second. Some switchboard systems react to a momentary on hook state. An exclamation point inserted in the dialing command causes the command to flash on hook for three-quarters of a second, just as if you had depressed the disconnect button (on the handset cradle) momentarily.

,	**Automatic Pauses in Dialing**

You can cause the command modem to pause during the dialing sequence by entering a comma character where the pause is desired. This pause will last two seconds. If a longer pause is desired, more than one comma may be entered consecutively, with each one causing a two second pause. You also have the option of changing the length of the pause of the comma, from two seconds to any other value from 0 up to 255 seconds. This is accomplished by accessing S-Register S8 which we explain in the Command Modem Commands Section.

Each comma used in a dialing command does count as one of the forty allowed characters.

;   **Returning toCommand Mode After Dial Command Execution**

A semicolon (**;**), when entered as the last character of a dialing command, will cause the command modem to return to the Command mode immediately after executing the command, instead of waiting for a carrier signal and going on line.

For example, entering **ATDT5551212;** would simply tone-dial the number, and do nothing afterwards except go back into Command Mode. This can be useful in dialing applications where command modem data transfer is not desired, such as voice communications.

+++   **Escape Sequences Entering Command Mode While Still On-Line**

It is possible to cause the command modem to enter the command mode after the command modem has gone on-line without disconnecting the call. This is accomplished by entering an Escape code. The default Escape code is three plus.signs (+++). You need not hit Return. The Escape code character may be changed by accessing S-Register S2 which is explained in the Command Modem Commands Section.

There is a safety factor built into the command modem, that requires about one second of silent time before and after the Escape code **+++** is entered, to prevent accidental escapes into the Command mode. The command modem will not release the telephone line until it receives an ATH or ATZ command, or it detects loss of carrier.

Appendix E

Command Modem S-Register Function

S0
Number of Rings Until Modem Answers
Unit:	1 ring
Range:	0-255
Default:	1
Description:	SO defines how many rings the command modem will wait before answering an incoming call. Default value is zero rings (Decimal 0), which means the Auto-Answer feature is enabled. The maximum number of rings that can be configures is 255.

S1
Rings Which Have Occurred
Unit:	1 ring
Range:	0-255
Default:	0
Description:	Counts the number of rings that have occurred. It is a "read" type of register, and will seldom, if ever, be used in normal operation. Each time an incoming ring signal is detected, S1 will increase its value by one, up to a maximum of 255. If you set the value of S1 to a vlaue other than its default value of zero, or if the value is increasing with rings, this new value will remainstored in S1 for only eight seconds, after which the value will revert back to zero.

S2
Escape Code Character
Unit:	ASCII Character
Range:	0-127
Default:	43 (*+ sign*)
Description:	Defines the escape code character. Default character is the plus sign + (Decimal 43). It may be set for any ASCII character. Setting an S2 value greater than 127 will result in there being no means of entering the Command mode from the On-Line mode.

S3
Return Character

Unit:	ASCII Character
Range:	0-127
Default:	13
Description:	Defines the character recognized as Carriage Return (RETURN) or "Enter". Default setting is CTRL-M (Decimal 13), which is the aSCII code for the Return key on most key boards. May be set for any ASCII character.

S4
Line Feed Character

Unit:	ASCII Character
Range:	0-127
Default:	10
Description:	Defines the character recognized as LINE FEED. Default setting is iCTRL-J (Decimal 10), which is the ASCII code for the Line Feed key on most keyboards. May be set for any ASCII character. If a Line Feed character is not desired, it may be changed to a nill, bit it can not be totally disabled.

S5
Backspace Character

Unit:	ASCII Character
Range:	0-32, 127
Default:	8
Description:	Defines the character recognized as BACKSPACE. Default setting is CTRL-H (Decimal 8), which is the BACKSPACE key on most keyboards. The backspace character must not be set to a value corresponding to a printable ASCII character (i.e., between 33 and 126) or greater than 127.

S6

Wait Time for Dial Tone

Unit:	1 second
Range:	2-255
Default:	2
Description:	Sets the time the modem waits after the RETURN key is pressed before executing a dial command. The delay allows time for the dial tone to occur on the telephone line. the minimum time is two seconds (Decimal 2) and is the factory default setting. Values greater than 2 seconds may be necessary if trouble is encountered getting dial tones.

S7

Time for Carrier (Abort Timer)

Unit:	1 second
Range:	1-255,
Default:	30
Description:	Defines the Abort Timer (lack of carrier) delay time. Default value is thirty seconds (Decimal 2). After dialing, the command modem will wait for acarrier signal for up to 30 seconds, and if none is detected, will abort the call. Maximum value is 255 seconds.

S8

Pause Time for Comma

Unit:	1 second
Range:	0-255
Default:	2
Description:	Sets the length of the pause caused by a comma inserted in a dialing command. The comma is used when it is necessary to dial through a PBX and wit for a second dial tone. Default setting is two seconds ro 2 units (Decimal 2) where each unit is one second. May be set fro up to 255 seconds.

S9
Carrier Detect Response Time

Unit:	.1 sec.
Range:	1-255
Default:	6
Description:	Sets the time delay for when the modem first detects a valid incoming carrier signal and when the modem turns on its Carrier Detect circuit. The default is 0.6 seconds or 6 units (Decimal 6) where each unit is 0.1 second. May be set for 25.5 seconds.

S10
Carrier Loss Disconnect Delay Time

Unit:	100 mSec.
Range:	1-255
Default:	7
Description:	Sets the time a carrier signal must be lost before the modem disconnects. The S10 default setting is 1.4 seconds or 14 units (Decimal 14) where each unit is 0.1 second. Maximum delay is 25.4 seconds (Decimal 254). Setting the S10 value at 255 causes the command momdem to not disconnect at all with loss of carrier.

S11
Tone Dialing: Tone Spacing and Duration

Unit:	1 mSec.
Range:	50-255
Default:	95
Description:	S11 defines the speed of the tone-dialing.The default value is 95 units (Decimal 95), where each unit is one msec, meaning that each tone will be on for 95 mSec with a 95mSec pause between each. The mimimum value allowed by most telephone systems is 50 msec (50 units). Very few telephone systems can handle anything faster than that. The maximum value is 255 msec.

S13Reserved
S14Reserved
S15Reserved
S16Reserved
S17Not Used

S18
Test Timer

Unit:	sec
Range:	0-255
Default:	00
Description:	Sets the length of time the command modem conducts a test before turning to command mode. If S18 is zero, the test will not automatically terminate; the test must be terminated from the command moce by issuing an AT&T0 or ATH command

S19 Not Used
S20 Not Used
S21 Reserved
S22 Reserved
S23 Reserved

S24
Sleep Mode Inactivity Timer

Unit:	Sec.
Range:	0-255
Default:	0
Description:	S24 is used to set the amount of time the modem may be inactive before it will enter the sleep mode. The range of S24 is 0 to 255. The Sleep Mode Inactivity Time is automotically set to 5 seconds and Sleep Mode is inhibited when S24 = 255.

S25

Detect DTR Change

Unit:	0.1 sec
Range:	0, 1 through 255
Default:	5
Description:	If in on-line or command mode, changes in DTR that last less than the time specified by S25, in 0.01 second increments, are ignored by the command modem.

S26 Reserved
S27 Reserved
S28 Reserved

Appendix F

Flow Control Background

Flow control refers to the techniques used by computer devices and multiplexers to stop and restart the flow of data from each other. Flow control is necessary so that a channel device does not receive more data than it can handle or vice versa (the MultiMux receives more data than its buffers can accommodate). Flow control by the mux to control data flow from a channel device is called Mux Initiated Flow Control. Such flow control might be needed if a mux was connected to a minicomputer that could output more data than the mux could handle. Flow control by the channel device to control data flow from the mux is called Channel Device Initiated Pacing. Such pacing might be required by a printer channel device which could not print data as fast as the mux might send it or might go off-line for some reason like running out of paper. To state it simply, "Flow Control" is something the mux does to the channel device, while "pacing" is something the channel device does to the mux.

MUX INITIATED
FLOW CONTROL

| Channel Device | → DATA → | Mux |

Flow control stops the
input of data to the mux

CHANNEL DEVICE
INITIATED PACING

| Mux | → DATA → | Channel Device |

Pacing stops the output
of data from the mux
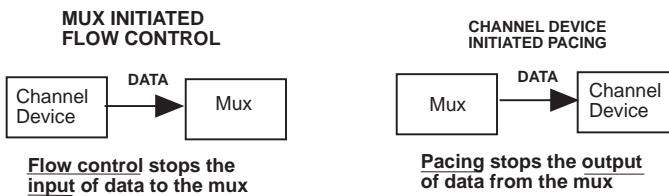
Flow control can be software or hardware based. In software flow control, special characters (Xon and Xoff) are used to stop and start the flow of data. In hardware flow control the Clear To Send (CTS) signal on the RS232C interface (pin 5) is brought low to stop data and high to restart it. When you select a flow control method with a mux command you are also selecting the corresponding pacing method.

In the example below we have an eight port multi-user minicomputer connected to a MultiMux on one end of a link and seven terminals plus a printer connected to another MultiMux on the other end of the link. The MultiMux at the printer end needs Flow Control and Pace on the printer channel to stop and restart data from the minicomputer. The MultiMux at the minicomputer end needs Flow Control on to all channels to stop and restart data from the minicomputer so that the mux's buffer capacity is not exceeded. We chose Xon/Xoff flow control for this example and are setting pace ON for all channel devices.
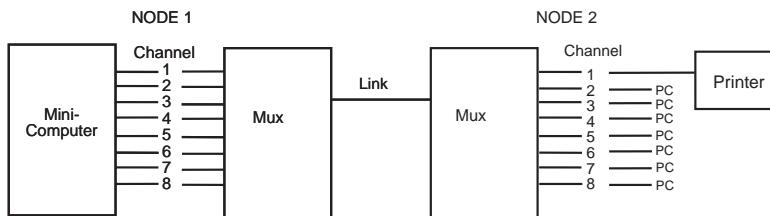
MiniComputer Flow Control

In the example below, the flow control on the minicomputer works as follows:
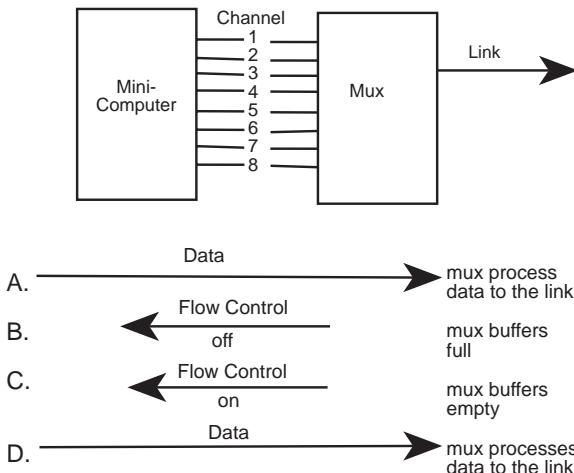
A. Data volume from the mini for any particular channel is appropriate for the mux to process and transfer on to the link.

B. Data overwhelms a channel's mux buffer and the mux sends a stop data Flow Control (OFF) signal to the mini stopping data output.

C. The mux buffer sufficiently enpties to allow additional data transfer, so the mux sends a start data Flow Control (ON) signal to the mini.

D. Data from the mini again flows through the channel.

Printer pacing and Flow Control

The example below shows how Pacing and Flow Control work on a printer.
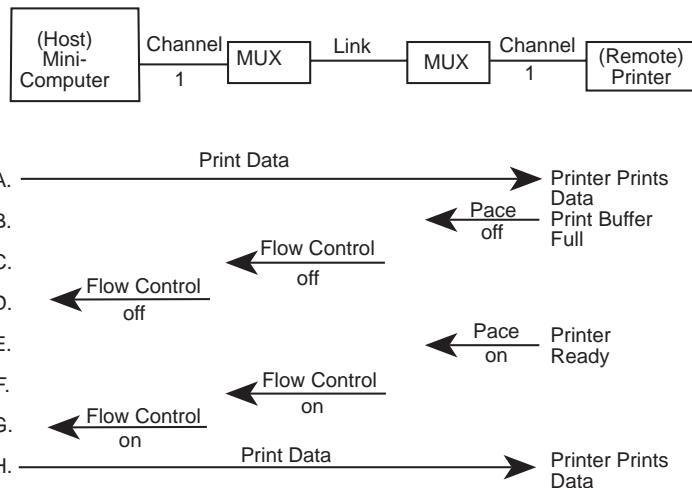
A. Print data volume from the mini is appropriate for the printer to process and print it.

B. The printer cannot handle any more data due to its buffers being full and it issues a Pace OFF signal to the mux.

C. The remote mux sends a Flow Control OFF signal to the other mux and uses its buffer to store any pending print data.

D. The host mux sends a Flow Control OFF signal to the mini and uses its buffer to store any pending print data.

E,F,G. The printer buffer empties and is ready for more print data, so it issues a Pace ON signal which, in turn, causes a Flow Control ON signal through to themini.

H. Print data from the mini resumes.

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Appendix G

MMH2834 S-Registers

Introduction

This section covers the MMH2834 memory (*option*) registers called S-Registers, where certain MMH2834 modem and command mode configurations are stored. Each S-Register is assigned a number (S0, S1, S2, etc.). Use the **S** command to read and/or change the value stored in an S-Register *(**ATSr?** to read and **ATSr=** to change S-Register values).

S0

Number of Rings Until Modem Answers

Unit:	**1 ring**
Range:	**0-255**
Default:	**1**

Description: S0 defines the number of rings the modem waits before answering an incoming call. The default value is one ring (Decimal 1), which means that the modem answers the call immediately after the first ring. The maximum number of rings that can be configured is 255. Setting the value to zero (0) disables auto-answer completely.

S6

Wait Time for Dial Tone

Unit:	**1 second**
Range:	**2-255, 4-255****, **4-7*****
Default:	**2, 4****,**4*****

Description: S6 sets the time the modem waits after the RETURN key is pressed before executing a dial command. The default setting is two seconds (Decimal 2).

* Value for International and DOC units

** Value for International units only

***BABT models only

S8

Pause Time for Comma

> **Unit:** 1 second
>
> **Range:** 0-255, 4-255**, 4-7***
>
> **Default:** 2, 4**, 4***

Description: S8 sets the length of the pause caused by a comma inserted in a dialing command. The default setting is two seconds, (or two units Decimal 2) or four seconds, where each unit is one second. S8 may be set for up to 255 seconds.

S8 also sets the time the modem waits before retrying a call after detecting a busy signal. Some computer systems need more than two seconds to reset (in which case you should increase the value of S8).

S11

Tone Dialing: Tone Spacing and Duration

> **Unit:** 1 mSec.
>
> **Range:** 1-255, 80-255*, 80-255***
>
> **Default:** 70, 80*, 80***

Description: S11 sets the speed of tone dialing (spacing and tone duration times). The default value is 70 units (Decimal 7) or 80 units, where each unit is one mSec, meaning that each tone is on for 70 mSec with a 70 mSec pause between each.

The minimum S11 value allowed by most telephone systems is 50 mSec (50 units). Very few telephone systems can handle anything faster than that. The maximum S11 value is 255 mSec (255 units).

* Value for International and DOC units

** Value for International units only

***BABT models only

S13

Remote Configuration Escape Character

> **Unit:** **ASCII Character**
>
> **Range:** **0-127**
>
> **Default:** **37 (%)**

Description: S13 defines the remote configuration escape character (which becomes your modem's remote configuration character). The default is three percent symbols (*%%%*). When the S13 character is entered three consecutive times from a remotely connected site, your modem responds with its Remote Configuration procedure.

S18

Automatic Leased Line Restoral

> **Unit:** **30 minutes**
>
> **Range: 10-255**
>
> **Default:** **30 minutes**

Description: When the MMH2834 is in dial back-up mode, it periodically checks the lease line to see if it is operational and tries to restore the lease line if possible. S18 defines how often attempts occur. The default of S18 is 30 minutes and can be set in one minute increments from 10 to 255 minutes. Setting the S18 restoral under 10 minutes causes excessive breaks in dial-up operation.

S19

Dial-Back Timer

> **Unit:** **1 minute**
>
> **Range:** **0-255**
>
> **Default:** **1**

Description: S19 is a timer that begins when the lease line goes down. S19 specifies the duration of time the modem attempts to reestablish the lease line connection.

Appendix H

Dial Back-up

The dialing associated with the MMH2834, when in leased line with dial-back mode, involves placing a call from the originating MMH2834 due to a leased line failure.

After a preset period of time, determined by S-Register S18 (refer to Appendix I for a description of the S-Registers), the MMH2834 automatically tries to restore the leased line.

The parameters used to determine if a leased line is down (so automatic dial-back can occur), is based on the MMH2834 doing a "retrain" on the leased line due to an error condition in the transmission. An error condition is defined as a "hit" on the line (the Carrier gets interrupted).

The retrain is a "handshake" procedure between the MMH2834s to establish the Carrier again. If the retrain fails, both MMH2834s (originate and answer MMH2834s) start their dial-back timers. The time is determined by S-Register S-19 settings. The S19 default setting is one minute. During that minute, the originate MMH2834 tries to establish the leased line link. If the leased line is established during that time, the timer is cleared and everything is back to normal. If the timer expires, the MMH2834 goes to dial-back mode.

The purpose of the timer for the Answer MMH2834 is to determine when it accepts a dial-up call. When both timers have expired and the leased line has not be established, the dial-back procedure starts. The number dialed is the one stored in location N9 of the originate MMH2834's phone number memory. In the preparation for proper dial-back operation, enter the proper number in the N9 location using the commands in Chapter 5.

Appendix I

Testing Your MMH2834

I.1   Introduction

Each time power is applied to a MultiMux with an internal MMH2834 modem, the MMH2834 performs an automatic self- test to ensure proper operation. The MMH2834 also has three diagnostic test features: Local Analog Loopback, Digital Loopback (remote/automatic) and Digital Loopback (local/manual). These diagnostic tests can be run after the modem is selected using the **#CLA1** command.

A loopback test involves entering data from your PC and looping that data through the circuits of your modem and/or a remote modem. When the loop has been completed, the original data entered should match the data received back on your PCs monitor after the test.

The Local Analog Loopback Test allows you to verify that the modem's transmitter and receiver circuits are functioning properly.

The Digital Loopback Test (local/manual) allows you to verify that the remote computer or terminal, the remote modem, serial ports, the telephone line and the local modem are functioning properly.

The Digital Loopback Test (remote/automatic) allows you to verify that the local computer or terminal, the two modems and the transmission line between them are functioning properly.

In asynchronous mode, upon completion of testing, enter either Escape Sequence, ***+++AT<CR>*** or ***<BREAK>AT<CR>***.

Note: All loopback tests will operate at all speeds except 300 bps.

I.2   Local Analog Loopback Test/V.54 Loop 3

In this test, data from your computer or terminal is sent to your modem's transmitter, converted into analog form, looped back to the receiver, converted into digital form and then received back at your monitor for verification. No connection to the phone line is required. See Figure I-1.

Computer or Terminal   Local MultiModem

UUUUU
UUUUU

Digital | Analog

Type **ATU0** or **ATU1;** hit ENTER
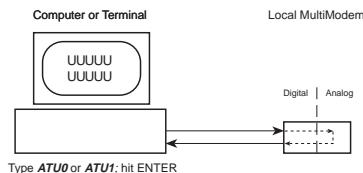
Figure I-1. Local Analog Loopback Test

The test procedure is as follows:

1. Connect the modem to your computer. With your communication software, set the desired baud rate.

2. Type **ATU0 (or ATU)** and hit ENTER. This places your modem in Analog Loopback mode, in the Originate mode. The modem is now out of the Command mode and in a pseudo On-Line mode.

3. Once you receive a connect message (if responses are enabled), enter data from your keyboard. For this test, typing multiple upper case "U" characters is a good way to send an alternating test pattern of ones and zeros.

4. For a more complete test, you should also test the modem in Answer mode. To do this, you must "escape" from Originate mode by entering an Escape Sequence (**+++AT<CR>** or **<BREAK>AT<CR>**) . Then type **ATU1** and hit ENTER to place the modem in Analog Loopback mode, in the Answer mode. Then repeat step 3.

5. When testing is completed, you may exit Answer mode by entering an Escape Sequence (**+++AT<CR>** or **<BREAK>AT<CR>**), which returns the modem to Command mode.

6. Your modem passes this test if the data entered from your keyboard are the same as the data received on your monitor. If different data is appearing on your monitor, your modem is probably causing the problem, although it could also be your computer. If your modem passes this test, but you are receiving errors while On-line, the remote modem or the phone line could be at fault.

I.3   Digital Loopback Test/V.54 Loop 2 (Local/Manual)

In this test, your modem must be On-Line with another modem that can respond to a request for Digital Loopback, such as another MMH2834. The Digital Loopback Test is an on-line test that loops data sent from one modem across the phone line to another modem, then back to the first modem. See Figure I-2.

There are two ways to put a modem into Digital Loopback mode.

1. Locally or Manually, described here in section I.3.

2. Remotely or Automatically, see section I.4.

Note: The Digital Loopback Tests can only be used with the modem in Normal mode (error correction off).

Computer or Terminal   Local MultiModem   Remote MultiModem   Computer or Terminal

UUUUU
UUUUU

Digital │ Analog   Analog │ Digital

Type *AT* in Terminal mode; hit ENTER; dial remote modem; establish On-line mode; enter escape sequence; type *ATU3* and hit ENTER
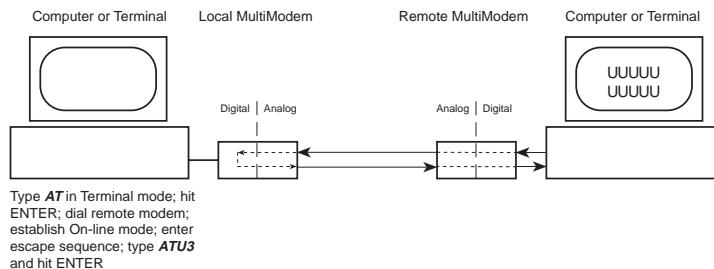
Figure I-2. Digital Loopback Test (local/ manual)

In this test the local modem is placed in Digital Loopback mode. Data is entered and transmitted from the remote modem (which is not in digital loopback mode), sent across the phone line to the local modem and looped back to the remote modem.

The test procedure is as follows:

1. Go into Terminal mode. Type **AT** and hit ENTER; you should get an *OK* message.

2. Dial the remote modem by entering the Dial command and the phone number, to establish On-line mode.

3. Type the Escape Sequence (**+++AT<CR>** or **<BREAK>AT<CR>**) which brings your modem into Command mode, while still maintaining the pseudo On-line mode with the remote modem.

4. Type **ATU3** from the local PC and hit ENTER. Once you receive an *OK* message from your modem (if responses are enabled), the local modem is placed in Digital Loopback mode.

5. Data is typed from the remote keyboard. For this test, typing multiple upper case "U" characters is a good way to send an alternating test pattern of ones and zeros. The data received by the local modem will enter its analog receiver, be converted to digital data, be reconverted into analog, and then looped through its transmitter back to the remote modem. Your modem passes this test if the data entered from the remote keyboard is the same as the data received on the remote monitor.

6. When testing is complete, you may end the test by typing an Escape Sequence (**+++AT<CR>** or **<BREAK>AT<CR>**) to bring your modem into Command mode. The modem should respond with an *OK* message. If you wish to stay On-line with the remote modem for normal data transmission, type **AT0** and hit ENTER. If you wish to terminate the call, type **ATH** and hit ENTER to hang up.

I.4   Digital Loopback Test/V.54 Loop (Remote/ Automatic)

In this test, your modem must be On-line with another modem set up to respond to a request for Digital Loopback, such as another MMH2834. With the MMH2834, this ability to respond is controlled by the *&T* command. *AT&T4* enables the response to Digital Loopback Test (remote/automatic). *AT&T5* disables the response. The modem defaults to disable on power up, so this must be changed on the remote modem before the modem will respond to a request for the Digital Loopback Test (remote/automatic).

Initiate the Digital Loopback Test (remote/automatic) with the *ATU2* command which automatically places the remote modem in digital loopback mode. Data from your computer or terminal are transmitted through your modem, and over the phone line to the remote modem, where they are then looped back to your modem. See Figure I-3.

Computer or Terminal   Local MultiModem   Remote MultiModem   Computer or Terminal

UUUUU
UUUUU

Digital | Analog   Analog | Digital

Type *AT* in Terminal mode; hit
ENTER; dial remote modem;
establish On-line mode; enter
escape sequence; type
ATU2; hit ENTER
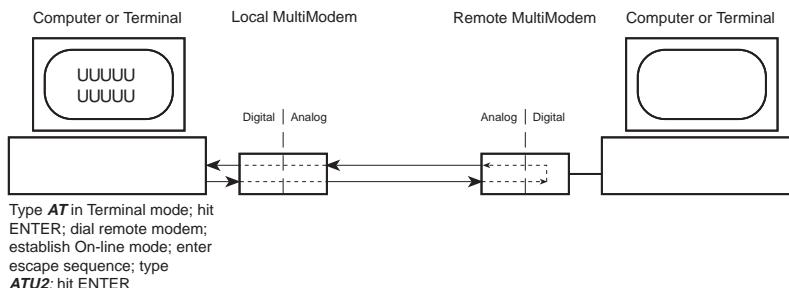
Figure I-3. Digital Loopback Test (remote/automatic)

The test procedure is as follows:

1. Go into Terminal mode. Type *AT* and hit ENTER; you should get an *OK* message.

2. Dial the remote modem by entering the Dial command and the phone number, to establish On-line mode.

Note: The *&T4* command must be set on the remote modem to run this test.

3. Type the Escape Sequence (***+++AT<CR>*** or ***<BREAK>AT<CR>***) which brings your modem into Command mode, while still maintaining the connection with the remote modem.

4. Type ***ATU2*** and hit ENTER. The local modem responds to this command by transmitting an unscrambled marking signal, which causes the remote modem to place itself in Digital Loopback mode. Then the local modem exits Command mode and enters pseudo On-line mode.

5. Type data from your keyboard. For this test, typing multiple upper case "U" characters is a good way to send an alternating test pattern of ones and zeros. The data received by the remote modem will enter its analog receiver, be converted to digital data, be reconverted into analog, and then looped through its transmitter back to the local modem. Your modem passes this test if the data entered from the local keyboard is the same as the data received on your monitor.

I.5 Synchronous Mode Testing

The following tests must be run with your modem in Synchronous mode. The test procedures for Synchronous mode are different from those for Asynchronous mode. In Synchronous mode, you cannot access the modem's AT commands.

There is also a Local Analog Loopback Test, documented in section I.6.

I.6   Local Analog Loopback Test (Synchronous Mode)

This test diagnoses the connection between your MMH2834 and your computer or terminal. In Local Analog Loopback Test mode, data entered at the local computer or terminal are sent through the local modem's transmit and receive circuits (much like entering an **ATU** or **ATU1** command in Asynchronous mode). You then compare the test characters (multiple upper case "U" characters in Figure I-4) on your monitor with the characters you typed. If the characters don't match, check your computer's COM port setting, then verify your communication software's configuration.

To initiate the Local Analog Loopback Test, with the modem in Synchronous mode:

1.   Enter **AT&M1U**. This first switches your modem from asynchronous to synchronous mode, and places it into the Analog Loopback/ Originate mode. The modem is now out of the Command mode and in the pseudo On-Line mode.

2.   Once you receive a connect message (if responses are enabled), enter data from your keyboard. For this test, typing multiple upper case "U" characters is a good way to send an alternating test pattern of ones and zeros.

3.   For a more complete test, you should also test the modem in Answer mode. To do this, Type the Escape Sequence (**+++AT<CR>** or **<BREAK>AT<CR>**) which brings your modem into Command mode, while still maintaining the connection. Then type **AT&M1U1** and hit ENTER to place the modem in Analog Loopback mode, in the Answer mode. Then repeat step 2.

Computer or Terminal   Local MultiModem

```
UUUUU
UUUUU
```

Digital | Analog

Answ/Orig
Switch toggled
to Orig Position
on Power-up
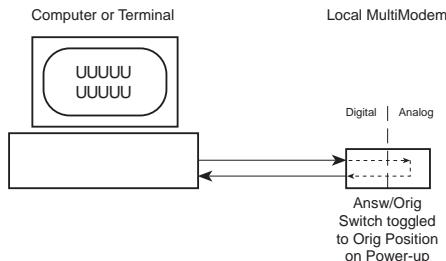
Figure I-4. Local Analog Loopback Test (Synchronous Mode)

I.7   Digital Loopback Test (Local/Manual) Synchronous Mode)

This test must be run when you have a data connection with another modem. If a Local Analog Loopback Test resulted in errors, and this test passes without errors, then the problem exists in your computer-to-modem connection. In Digital Loopback Test (local/manual) mode, data passed from the remote modem's transmit circuit are looped back from the local modem and are received at the remote modem's receive circuit (multiple upper case "U" characters in Figure I-5).

First make certain that you are set up for Synchronous operation by displaying the composite link configuration and ensuring that the link format is sync. Sync mode is set using the **$M(Sync)** command. Once you receive an *OK* message from your modem (if responses are enabled), the local modem is placed in Digital Loopback mode.
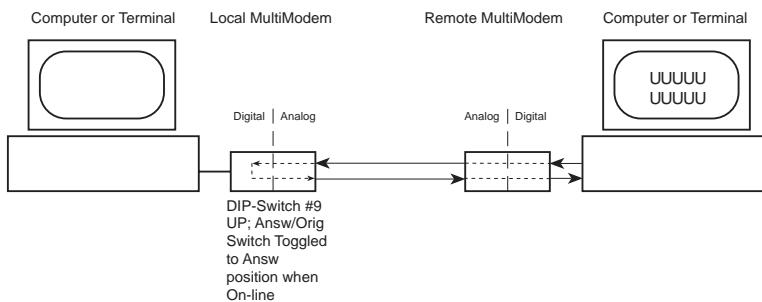
Figure I-5. Digital Loopback Test (local/manual) (Synchronous Mode)

I.8   Digital Loopback Test (Remote/ Automatic)(Synchronous Mode)

This test must be run when you have a data connection with another modem. In this test, data is passed to the remote modem and is looped back to the local modem (as if an **ATU2** command was issued in Asynchronous test mode), as shown in Figure I-6. This lets you test the local and remote modem's transmit and receive circuits, as well as your computer's serial COM port and the phone lines. If the test results in a mismatch of entered/received data (multiple upper case "U" characters in Figure I-6), the Local Analog Loopback Test should be performed on both the remote and local modems. If that test is successful, the problem may be the phone lines.

First make certain that you are set up for Synchronous operation by displaying the composite link configuration and ensuring that the link format is sync. Sync mode is set usng the **$M(Sync)** command. Once you receive an *OK* message from your modem (if responses are enabled), the local modem is placed in Digital Loopback mode.

Figure I-6. Digital Loopback Test (remote/automatic) (Synchronous Mode)

Appendix J

Internal MMH2834 Composite Link Modem Commands

J.1 Introduction

Before the internal MMH2834 composite link modem commands can be entered, access to the modem has to be activated using the composite link access (**#CLA1**) command. When the MMH2834 modem is configured, the composite link access (**#CLA0**) command disables access from the command port to the composite link. The following sections describe the MMH2834 modem commands.

Table J-1. MMH2834 Command Summary

TYPE	COMMAND	DESCRIPTION
MMH2834 Modem	*D*	Dial
Dial	*A: or :*	Continuous Redial
	$D	DTR Dialing
	N	Dial a Stored Number
MMH2834 Modem	*P/T*	Pulse/Tone Dialing
Modify Dialing	*&P*	Set Pulse Dial Ratios
Procedures	*,*	Automatic Pauses in dialing
	Y	Long Space Disconnect
	W	Wait for New Dial Tone
	R	Reverse Mode of Operation
	!	Flash On Hook
	$	AT&T *"Calling Card"* Tones
	@	Quiet Answer
MMH2834 Modem	*D...N*	Store Phone Numbers
Memorize Phone	*NN*	Number Linking
Numbers	*L*	List Numbers Stored in Memory

MMH2834 Modem	***&F***	Load Factory Defaults
Store Modem	***&W***	Store Configuration & S-Register
Configurations		Parameters
and Defaults	***Z***	Reset Modem
	V	Result Code Terse/Verbose
	&M	Synchronous/Asynchronous Mode
		Select
	&X	Synchronous Transmit Clock Select

MMH2834 Modem	***Q***	Result Codes Enable/Disable Response
Configure	***&Q***	Result Code Selection
Command	***E***	Echo Command Characters
Responses	***V***	Result Code Terse/Verbose
	X	Result Code...Basic/Extended/Call
		Progress

MMH2834 Modem	***&T***	Remote Digital Loop Signal
Condition	***#T***	Enable/Disable Trellis Coded Modulation
Phone Line		

MMH2834 Modem	***&D***	Data Terminal Ready Control
RS232C Interface		

MMH2834 Modem	***#L0***	Negotiate V42 Mode During Handshake
Configure	***#L1***	MNP On/LAPM Off
Error	***#L2***	LAPM On/MNP Off
Correction	***#L3***	Direct LAPM/Phase Out Handshake
(Section J.1.8)	***$A***	Auto-Reliable Buffering
	$F	Enable/Disable Auto-Reliable Fallback
		Character
	$R	Retransmit Count
	$E	Error Correction at 300 bps

MMH2834 Modem	***&BS***	Maximum Block Size
Compression &	***&E14***	Data Compression Disabled
Block Size	***&E15***	Data Compression Enabled

MMH900 Series Statistical Multiplexer

MMH2834 Modem	**$BA0**	Speed Conversion On
Configure Speed	**$BA1**	Speed Conversion Off
Conversion	**$MB**	Set modem speed (e.g.,$MB28800)
	$SB	Set serial port speed (e.g.,$SB115200)

MMH2834 Modem	**$H**	Help
Execute	**I**	Product Code Inquiry
Immediate	**L5**	List Current Operating Parameters
Action	**L6**	List S-Register Values
Commands	**L7**	List additional Configuration Parameters
	L8	List On-Line Diagnostics

MMH2834 Modem	**Sr?**	Read Current S-Register Value
Read and	**Sr=**	Assign S-Register Value
Assign		
S-Register		
Values		

MMH2834	**#CBN**	Passwords for Callback Phone Numbers
Remote	**#DB**	Callback Security Enable/Disable
Configuration	**#I**	Change LOGIN Password
& Callback	**#RCBNxx**	Erase Password
Security		Linked with Memory Location *xx*
	#S	Change SETUP Password

MMH2834 Modem	**U**	Self-Test Modem
Test	**&T**	Enable/Disable Digital Loopback Signal

J.1.1   Dialing Action Commands

Dial
Command
D

The letter *D* in a command causes the MMH2834 to dial the telephone number immediately following it. For example, if you enter **ATD5551212** and hit RETURN, the MMH2834 dials the number 555-1212.

The MMH2834 gives you several choices of dialing methods. You can use tone or pulse dialing, by inserting a letter *T* or a *P* in the command string. (See section J.1.2 on Dial Modifiers)

You can also configure the modem to either wait for and detect dial tones and busy signals (which we call *"Wait-for-Dial-Tone"* dialing or *"Smart"* dialing), or work with timed pauses without dial tone and busy signal detection (which we call *"Blind"* dialing; see Section J.1.5, *"X"* Command.)

Note: There is another method of dialing, called *"DTR Dialing"*, where by manipulating the DTR signal on pin 20 of the RS232C/ V.24 interface, a number stored in the modem's memory is automatically dialed. See Section on DTR Dialing (*$D* command) for details.

Continuous Redial

A: or :

If you select the Wait-For-Dial-Tone method of dialing (see X3 or X4 command), you can command the MMH2834 to continuously redial (up to 10 redials for DOC units) a busy number until your call is answered. This is done with the *A:* command.

This command would be used only if you had already reached a busy number after executing a normal dial command. You simply enter *A:* (you need not enter AT, nor do you need to hit RETURN), and the modem will redial the number for you. If you again reach a busy signal, it redials again and again until it no longer detects a busy signal. You can stop the MMH2834 from redialing by pressing any key.

Another method used to cause the modem to redial a phone number continuously is to enter a colon *:* at the end of the phone number. The result is the same as if you had entered *A:* after personally observing that the number was busy on the first dialing attempt. Using the colon in the dialing string is a step saver.

Dialing a Stored
Number

A telephone number that you have stored in the MMH2834's number memory may be automatically dialed by entering

N	**ATNn** where n = 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9. For example, a number stored at N3 would be dialed by entering **ATN3** and RETURN. Do *not* include the letter D in this command, or the stored number will be erased (also see Section J.1.3., on Phone Number Memory Commands).
DTR ***Dialing*** ***$D***	An alternate method of causing the MMH2834 to automatically dial is DTR Dialing. Data Terminal Ready (DTR) is a signal that comes into the modem from the terminal or computer to which it is connected, on pin 20 of the RS232C interface. In DTR dialing, the modem automatically dials a stored number as soon as it receives a high DTR Signal. The DTR dialing method is popular in synchronous applications.

To activate DTR Dialing, enter **AT$D1** and hit RETURN. The modem dials the phone number stored in the N0 location of memory when it receives a high DTR signal. DTR must remain high for the duration of the call, until disconnect. To deactivate DTR dialing, enter **AT$D0** and hit RETURN.

J.1.2   Dial Modifier Commands

Pulse or Tone Dial
P

The MMH2834 dials numbers using either pulse or tone
dialing, or a combination of both methods. Pulse dialing is a
method used by rotary-dial telephones, which involves the timed
opening and closing of line relay.

T

Tone dialing is the method used by pushbutton (*touch tone*)
telephones, and is sometimes referred to as DTMF, or Dual-
Tone Multi-Frequency dialing.

The method used is selected by including a **P** for **Pulse** or a **T** for
Tone in the dialing command, right before the digits you wish to
have dialed in that manner.

For example, you would pulse-dial the number 555-1212 by
entering ATDP5551212 and hitting RETURN. You could tone-
dial the same number by entering ATDT5551212 and hitting
RETURN. If neither Pulse nor Tone dialing is specified in the dial
command, the MMH2834 uses whatever method used last. If the
modem has been reset or just powered up, it uses Pulse dialing,
even if the letter P is not included in your dial command.
Nearly all telephone systems in the U.S. are now compatible with
tone dialing. Since that is the faster method, you will probably
choose the tone method for your dialing.
An example of combining pulse and tone dialing could involve a
PBX system where 9 had to be pulse-dialed first, then the rest of
the number tone-dialed after pausing for a second dial tone. The
number would be dialed by entering **ATDP9**, **T5551212** and
RETURN. (The comma causes a pause, which we'll explain
soon.)

Set Pulse
Dial Ratios
&P

This command sets the time ratios between the open and
closed portions of the dialing pulse frequencies. To set the
dialing pulse ratio of 60 mSec to 40 mSec, enter **AT&P0.** To set
a ratio of 67 mSec to 33 mSec, enter **AT&P1**. The factory default
is **&P0**.

Automatic
Pauses in
Dialing
,

You can cause the MMH2834 to pause during the dialing
sequence by entering a comma character where the pause
is desired. This pause will last two seconds. If a longer
pause is desired, more than one comma may be entered
consecutively, with each comma causing a two second pause.
You also have the option of changing the length of the pause
caused by the comma, from two seconds to any other value from
0 up to 255 seconds. This is done by setting S-Register S8 (refer
to Appendix I). Each comma in a dialing command counts as one
of the sixty allowed characters.

Long Space Disconnect *Y*	When two modems are connected in Normal mode (i.e. withouterror correction) there is no *"polite"* means of requesting a disconnect. A link disconnect request packet is sent under reliable connections. As a result some *"garbage"* may be received when a hangup command is issued. The **Y1** command enables the modem to use the break signal which accomplishes the hangup as an instruction to shut off its receiver and disconnect (both modems must have **Y1** enabled for this feature to be effective). **Y0** (factory default) disables this function.
Wait for New Dial-Tone *W*	A **W** inserted in the dialing command causes the MMH2834 towait for another dial tone, and not resume dialing until another dial tone is detected. It is not necessary to enter a W at the beginning of the dialing command to wait for a modem dial tone, because the modem will do that first (pause automatically). In order for this command to work, you must select Wait-For-Dial Tone dialing with the **X2** or **X4** command, so that your modem will be able to detect the dial tone.
Reverse the Mode of Operation *R*	In certain operations you may need to reverse the mode of operation for your modem from originate to answer or answer to originate so that it would answer the phone and go into answer mode. This command turns off the reversing function with the **R0** command and turns it on with the **R1** command with the modem in either command mode. If you want to reverse from the originate mode, use **R** (with no number) in the dialing string.
Flash On Hook *!*	Some switchboard systems react to a momentary On Hook. An exclamation mark inserted in the command causes the modem *"flash"* on hook for a half of a second (90 mSec in BABT), as if you had held the switch hook button on a telephone down for a half second. For example, to flash On Hook after dialing the number 555-1234 in order to transfer to Extension #5678, you might enter **ATDT5551234,,!5678**. The commas cause a 4 second pause (just to be safe).

"Calling Card"
Detect Tones

$

The MMH2834 has the capability to detect **AT&T** ""*calling card*'' tones for the purpose of utilizing the user's calling card number to originate an on-line connection. An *$* symbol placed in the dialing string causes the modem to pause and wait for an **AT&T** *"calling card"* or a 1600 Hz tone (prevalent in the United Kingdom). When the tone is detected, the rest of the dialing string is processed. If no tones are detected within 45 seconds the modem aborts by indicating a *NO CARRIER* message.   Hitting any key also aborts the *$* command. The following is an example of this command:

ATDT1028806127853500 **$**123456789
   (access/phone number)   (credit card number)

Quiet Answer

@

The *@* command causes the MMH2834 to wait before processing the next symbol in the dialing string. The wait is for one or more ringbacks followed by 5 seconds of silence.
If 45 seconds pass before the rings and silence, a *NO ANSWER (R)* result code is processed. The *@* command is used for accessing a system that does not provide a dial tone.

For example, ***ATDT5551212@6313550*** causes the MMH2834 to dial the first number (555-1212) and wait for 45 seconds for at least one ringback and 5 seconds of silence. If a busy signal is detected, the MMH2834 hangs up and generates a *BUSY* result code. If it does not detect 5 seconds of silence, a *NO ANSWER* result code is generated after hanging up. If 5 seconds of silence is detected, the second number (631-3550) is then dialed.

J.1.3   Phone Number Memory Commands

Storing Phone Numbers

A telephone number and command line of up to sixty characters may be stored in the MMH2834's number memory. As many as ten of these numbers may be stored.

D...N

Each number will be given a name, using the codes N0, N1, N2 up to N9. A phone number is stored by entering *ATD*, then the number as it would be dialed, along with any *P, T, R, ;* or comma characters, and then entering *N* followed by the number's *"name,"* which would be any number from 0 through 9, and then hitting RETURN.

For example, the tone-dialed number 1-612-631-3550 would be stored as number *N3* by entering *ATDT16126313550N3* and RETURN. The number is *not* dialed with this store command. After storing a number, check to see that it has been stored correctly by typing *ATL* and hitting RETURN.

When phone numbers are stored, the entire command line is also stored so that you can effectively create a macro for each number. For example, if you know a particular number needs to have extended result codes, detect busy or dial tone, error correction, Xon/Xoff flow control, pacing, and data compression enabled,the command line would be: *ATX4&E1&E5&E13&E15DT16126313550N3*. This would store the entire command at location *N3*.

Number Linking

You may command the MMH2834 to dial another number automatically if the first number dialed is bysy. This would

NN

be useful in a situation where a computer can be accessed through more than one phone number. This is called *"linking"*. To link the number in N1 to the number N2, simply enter **ATN1N2** and hit RETURN. Several numbers can be linked in the same command. For example, you could link N1 to N2 to N3 to N4 by entering **ATN1N2N3N4** and RETURN or you could link N1 to N2 and back to N1 and then back to N2 by entering **ATN1N2N1N2** and RETURN.

The only limit on the number of numbers that can be linked is the 60 characters allowed in a command line. Number linking can not be used with blind dialing, since busy signals would not be detected. You would have to select the Wait-for-Dial tone dialing method using the *X* Command in order to use the Number Linking feature.

Listing Numbers
Stored in
Memory
L

Telephone numbers that you have stored in the MMH2834's memory may be listed and displayed with the **L** command. It willdisplay all ten stored N numbers in a format like that shown below. All digits and command letters will be shown. The number's *"name"* (0 thru 9) is shown first, followed by the complete dialing command and telephone number as originally entered.

Simply enter *ATL* and hit RETURN to display these numbers on your video screen or printer. An example of an **L** command listing is shown below:

0	*T14082345678*
1	*T16125551212;*
2	**P9,T14089876543**
3	**T3738315,12101,16126313550**
4	*T6313551R*
5	
6	*P9,4258513*
7	
8	**X4&E1&E5&E13&E15DT16126313550**
9	*T12138880123*

195

J.1.4   Configuration and Default Storage Commands

Store Configuration & S-Register Parameters in Non-Volatile Memory

&W

The MMH2834 can store configuration parameters and S-Register values in its non-volatile read/write Random Access Memory (RAM) memory. The **&W** command does this which prevents any reconfiguration from being lost on a power-down or Reset (ATZ) condition. **&W0** (or **AT&W**) causes the MMN2834 to store your customized AT command settings and S-Register values in its nonvolatile RAM. **&W0** also sets the modem so that it reads your customized settings stored in nonvolatile RAM when powered down or reset. (The **&W0** command only changes the settings stored in nonvolatile RAM that you specifically intend to alter. All other default parameters are applicable.)

&W1 causes the MMH2834 not to store your customized settings to nonvolatile RAM so that, after powering down or resetting the modem, it reads the factory default settings stored in ROM.

Loading Factory Defaults

&F

The **&F** command provides a choice between customized configuration settings in RAM and the factory default configuration settings in ROM. The **&F8** and **&F9** commands define the function of the **&F** command.

The MMH2834 is shipped from the factory with a pre-configured set of command and S-Register default settings. This set of factory defaults can be recalled by issuing the **&F** command. In addition to being able to recall the factory-installed defaults, the **&F** command can also recall those defaults stored under **&W0**. This is done using the **&F9** command.   If you have stored parameters with the **&W0** command and wish these settings to always be used as your defaults, you would enter **&F9&W0**. To return the **&F** command to read factory installed defaults, enter **&F8&W0**. **&F8** is the factory default.

Many datacomm programs, including *MultiExpress™* and *MultiExpress for Windows™*, issue the **&F** command automatically- the **&F9** command allows the user to select their own defaults. Note that the **&F8/F9** commands should be used with **&W0**.

Modem Reset

Z

The **Z** command can be used to reset the entire command mode buffer and the result is the same as if you had disconnected, and then reconnected power to the modem. When an **ATZ** command is executed, the state of the &W command determines where the default values originate. **&W0** defaults come from RAM and **&W1** defaults come from ROM.

Async/Sync
Mode
Switching
   &M

This command can be used to set the on-line mode to either synchronous or asynchronous. **AT&M0** will set the MMN2834 to Asynchronous mode, and all communications will be Asynchronous, in both On-line and Command modes. *AT&M1* causes the MMH2834 to communicate asynchronously when in Command mode and switch to synchronous mode while on-line. The modem defaults to *&M0* (asynchronous communications) on reset or power-up.

Synchronous
Transmit Clock
Select
   &X

The **&X** command selects the Synchronous Transmit Clock Source in conjunction with the MuxClock ($MUXCL) command for the composite link. External clocking is the default condition. External clocking is when the DTE provides transmit clocking to the modem on pin 24 of the RS232C interface.

&X0 is the default setting which is internal clocking. Internal clocking is when the modem provides transmit clock to the DTE on pin 15 of the RS232C/V.24 interface. The **&X1** command selects External clocking.   **&X2** enables Slave Clocking. The **&X2** Command causes the MMH2834 to generate the transmit clock timing (pin 15) from the receive clock (pin 17) from the DTE (therefore 15 and 17 are the same). In this mode (Slave Clocking), all timing is controlled by the receive clock.

J.1.5   Command Response (Result Code) Commands

Echo Command Mode Characters

E

If the MMH2834 is connected to a full-duplex computer, it may be necessary for the modem to be configured to echo back characters entered while in the command mode in order for them to be displayed. The **E** command is used to configure the Command Mode echo, with **ATE0** disabling the echo and **ATE1** enabling the echo (default).

Result Codes Enable/Disable and No Response Answer

Q

The *Q* command enables or disables Result Codes and the No Response Answer mode of operation. Result Codes may be disabled altogether in certain applications, such as computer-controlled auto dialing, using the *Q* command. **ATQ1** disables Result Code transmissions. *ATQ0* (or *ATQ*) enables Result Code transmission.

Regarding No Response Answer, you may want the answer mode handled without responses and echo turned off, but want the originate mode still intelligent. This is called the No Response Answer mode. *ATQ2* selects the No Response Answer mode. If you do not select any mode, the factory default setting (enable Result Codes) is automatically selected.

Result Codes
("Multi-Tech" or
"Standard AT")
&Q

The MMH2834 gives you a choice between the Multi-Tech Result Codes, and Result Codes that more closely match the standard AT command set responses.

AT&Q1 selects AT responses with no Reliable/Compression modifiers. With this command, the terse result code for *CONNECT 2400* is *10*.

TERSE	VERBOSE
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR
5	CONNECT 1200
6	NO DIAL TONE
7	BUSY
8	NO ANSWER
10	CONNECT 2400
11	CONNECT 4800
12	CONNECT 9600
13	CONNECT 14400
19	CONNECT 19200
21	CONNECT 21600
24	CONNECT 24000
26	CONNECT 26400
28	CONNECT 28800

AT&Q0 selects **Multi-Tech responses** with Reliable/
Compression modifiers. With this command, the terse result
code for *CONNECT 2400* is *9*.

TERSE		VERBOSE
0		OK
1		CONNECT
2		RING
3		NO CARRIER
4		ERROR
5	*	CONNECT 1200
6		NO DIALTONE
7		BUSY
8		NO ANSWER
9	*	CONNECT 2400
11	*	CONNECT 4800
12	*	CONNECT 9600
13	*	CONNECT 14400
19	*	CONNECT 19200
21	*	CONNECT 21600
24	*	CONNECT 24000
26	*	CONNECT 26400
28	*	CONNECT 28800

* When error correction is used, the word *RELIABLE* (verbose) or the letter *R* (terse) is added to these
responses. When data compression is used, the word *COMPRESSED* (verbose) or the letter *C* (terse) is
added to these responses

Result Codes
(Verbose/Terse)

V

The **V** command controls whether the MMH2834's result
MMH2834's result codes are displayed as word (*"verbose"*) or
single digit (*"terse"*) messages.

For example, if after dialing, no carrier signal is detected, the
resulting message can be displayed either as *NO CARRIER*, or
as the digit *3*.
Entering ***ATV0*** (or ***ATV***) causes the MMH2834 to display the
Result Codes as digits, while ***ATV1*** displays them as words. If
you do not select a method, the factory default setting causes
the modem to display Result Codes as words.

Result Codes (Basic and Extended) and Call Progress Selection

X

The **X** Command is used to select one of two possible dialing methods (""dumb or ""smart"), and to select various response combinations related to these methods. You can choose to have certain responses suppressed, or whether or not you want speed indications along with the *CONNECT* responses. You can also pick and choose certain responses in order to match up with *"Standard AT"* responses. (Refer to Appendix F for a summary of Result Codes.)

The MMH2834 provides *"Basic"* and *"Extended"* Result Code sets. The difference between the two is the Basic set provides one response (*CONNECT*) to indicate a connection, while the Extended set provides several responses for different ÿpeeds (*CONNECT*, *CONNECT 2400, CONNECT 4800, CONNECT 9600, CONNECT 14400 CONNECT 19200, CONNECT 21600, Etc.*).

When the Extended set is chosen, you also have the option of matching them up with Standard AT 2400 response code sets, by including or not including the BUSY and/or NO DIAL TONE responses while excluding the DIAL TONE response. The **X** command is used to select which responses are provided.

Regarding the MMH2834's method of dialing, the MMH2834 can detect standard dial tones and busy signals. This capability (*"smart dialing"*) allows the modem to wait for a dial tone, and when one is detected, to begin dialing immediately.

The MMH2834 also can detect a distant busy signal, if after dialing, it reaches a busy number. This is useful because it allows the modem to immediately abandon a call, rather than wait 45 seconds for a carrier signal that will never come.

The MMH2834 gives you a choice between the **wait-for-dial-tone** (*"smart"*) method we just described, and **blind** (*"dumb"*) **dialing**, where instead of detecting actual dial tones, the modem relies on timed pauses. When the wait-for-dial-tone method is chosen, the busy signal detection capability is also activated. The **X** command is also used to select which dialing method is used.

Five different *X* commands are available (X0 through X4), with five different effects on the MMH2834's Result Codes.

X0   Provides the basic (short) result codes and provides *"dumb"* dial capabilities.

X1   Provides the extended result codes and provides *"dumb"* dial capabilities.

The remaining *X* commands affect Call Progress, and turn on Extended Result Codes.

X2   Looks for *dial tone only* and will not provide a busy response.

X3   Looks for busy only and not look for dial tone.

X4   Looks for dial tone and for busy.

The factory default setting is **X0,** which selects Basic Result Codes and the blind (*"dumb"*) method of dialing.

J.1.6   Phone Line Conditioning Commands

Enable or Disable Recognition of Remote Digital Loop Signal
&T

The MMH2834 has several self-test features (covered in Appendix J). The tests are activated with different U commands, such as **ATU1**, and so forth. The **&T** command is a phone line conditioning command that enables or disables the modem's ability to recognize the Remote Digital Loop (*RDL*) test signal.

The **AT&T4** command lets the MMH2834 respond to a RDL signal, and places itself in digital loop. The **AT&T5** command causes the modem to ignore the RDL signal. The factory default is **&T5**.

Enable/Disable Trellis Coded Modulation
#T

This command enables or disables the Trellis Coded Modulation of the MMH2834. There is usually no need to disable (turn-off) Trellis codings except under an unusual line condition called impulse noise. **AT#T0** turns Trellis coding off and **AT#T1** turns Trellis coding on (factory default).

Fallback Modes When On-Line

#F

If line conditions deteriorate, the MMH2834 automatically drops its transmission speed (*"fallback"*). The **#F** command control the different ways the MMN2834 falls back. During operation, if the error rate becomes too great, the modem performs a retrain. If after the retrain, the error rate is still too high for 28800 bps operation, the modem initiates a retrain at 4800 bps.If after the first retrain the modem returns on line at 28800 bps, the modem then starts a counter and a timer. If three retrains occur within a two minute period, the modem falls back to 4800 bps. Entering **AT#F0** (or **AT#F**) allows no fallback when on-line. **AT#F1** allows the MMH2834 to fallback (based on the error rate or if three retrains have occurred within a two minute period) from 28.8K to 26.4K to 24K to 21.6K to 19.2K to 16.8K to 14.4K to 12K to 9.6K to 4.8K bps.   The **AT#F2** command enables incremental fall back from 28.8K to 4.8K, but also enables incremental fall forward (from 4.8K to 28.8K) if the phone line improves. **AT#F2** is the factory default setting.

J.1.7 RS232C Interface Control Commands

*Data Terminal
Ready Control*

&D

Data Terminal Ready (DTR) on pin 20 of the RS232C interface is required in order for the MMH2834 to operate. A high DTR signal tells the modem that the device to which it is connected is active, or *"ready"* to communicate through the modem. DTR has some other MMH2834 functions. DTR can be used to trigger a dialing sequence, called DTR Dialing. The condition of DTR can also be used to cause the modem to reset to its default parameters, just as if   you had given the modem an ATZ command. To do this, enter the command **AT&D3** and hit RETURN. The modem will now reset itself whenever DTR is dropped from On to Off, and will also go on-hook (hang up) if it is on-line.

Entering **AT&D0** or **AT&D** causes the MMH2834 to ignore DTR. Entering **AT&D1** causes the modem to go on-hook (*hang up*) with loss of DTR. The modem enters Command mode when DTR goes high again. Auto-answer is disabled while DTR is low. Entering **AT&D2** causes the modem to go on hook with loss of DTR. The modem enters command mode when DTR goes high again.

J.1.8   Error Correction Commands

You can use AT commands to place your MMH2834 one of three V.42 (error correction) modes of operation.

V.42 Mode Select **#L**	The V.42 standard implements both MNP Class 3 & 4 and LAP-M error correction methods. The V.42 Mode Select command (**#L**) selects which type of error correction (MNP or LAP-M) your MMH2834 uses for transmissions.
	The various **#L** command options are as follows.
#L0 Command	The **#L0** Command allows a pair of modems to negotiate which V.42 mode **(MNP or LAP-M)** will be used in their transmissions.

<div align="center">

Originate Mode

</div>

a. If both modems have LAP-M capability, the modems use LAP-M mode.

b. If one or both modems do not have LAP-M capability and both have MNP, the modems use the MNP mode.

<div align="center">

Answer Mode

</div>

a.   The answering modem responds to either an MNP Link Request or LAP-M Originator Detection Pattern (ODP) signal depending on which the originating modem issues.

#L1 Command	The **#L1** Command sets your modem to MNP error correction and disables LAP-M. This command is for Originate mode only. In Answer mode, the modem still accepts MNP or LAP-M.
#L2 Command	The **#L2** Command sets your modem to LAP-M error correction, and disables MNP. This command is for Originate mode only. Answer mode still accepts MNP or LAP-M.
#L3 Command	In the prior commands, the modems use a two phase process to establish a V.42 connection (detection to establish whether the remote modem is also error correcting, and then protocol establishment to determine parameters and to establish the error correction connection). If you know that the other modem is a V.42 error correcting modem, and you wish to use LAP-M, the **#L3** command disables the detection phase and goes directly to protocol establishment. Both modems must have **#L3** in effect.
Auto-Reliable Buffering	In Auto-Reliable mode, the modem is given four seconds to establish a Reliable connection. After this four-second period, the modem drops to Normal mode.
$A	Any data which is received during this period is typically discarded. The **$A** command can be used to cause the modem to buffer (save) data that is received during this Auto-Reliable time-out period. This data will then be output by the modem after the *CONNECT* message
	AT$A0 = Discard data received during auto-reliable time period.
	AT$A1 = Buffer data received during auto-reliable time period. The factory default is **$A0**.

Enable/Disable Auto-Reliable Fallback Character $F	In Auto-Reliable mode, the modem is given four seconds to establish a Reliable connection. If a single CARRIAGE RETURN is received from the remote modem during this four second period, the Auto-Reliable modem assumes that the remote modem is not in Reliable mode and drops to Normal mode. The CARRIAGE RETURN is the only character which causes the modem to drop to Normal mode. Any other character will either be buffered or discarded.

The ***$F*** command can be used to disable this fallback-to-Normal-due-to-CARRIAGE-RETURN feature.

The Auto-Reliable fallback character (***$F***) and Auto Reliable buffering (***$A***) commands can be used together to cause the modem to buffer all data received up until the CARRIAGE RETURN, and then drop to Normal mode. All data received will then be output following the *CONNECT* message.

AT$F0 = Do not fall back to Normal if CARRIAGE RETURN received.
AT$F1 = Fall back to Normal mode if CARRIAGE RETURN received.
The factory default is ***$F1***.

Retransmit Count $R

If errors are received during a Reliable connection, the modem re-sends the block of data which contained an error. With the ***$R0*** command, if another error occurs, the block will be re-sent again. The modem counts the number of times that a data block is re-sent. If the same block of data is resent 12 times and still has not been received properly, the modem assumes that the transmission line is unsuitable for transmission, and abort the connection.

This retransmit counter is disabled by the ***$R1*** command. When the retransmit counter is disabled, the modem keeps trying to send data and will not abort, no matter how many times the same block is resent.

AT$R0 = Disconnect if retransmit count is exceeded.
AT$R1 = Do not disconnect due to retransmits.
The factory default setting is ***$R0***.

V.42 Error Correction/300bps $E

At 300 bps, error correction is not typically used. ***$E1*** lets the lets the MMH2834 function at 300 bps in either Normal (***&E0***), Auto-Reliable (***&E1***) or Reliable (&E2) mode. ***$E0*** which is the the MMH2834's default, disables 300 bps/V.42 error correction altogether.

J.1.9   Compression and Maximum Block Size Commands

Data Compression   The data compression (**&E14**) command enables data compression.

Maximum   The maximum size of Reliable mode data blocks can be controlled
Block Size   with the **&BS** command.   MNP 3 sends blocks of 1 to 64 characters. MNP 4 and 5 typically send blocks of 1 to 256
  &BS   characters and LAP-M typically sends 128 characters. For MNP classes 4 and 5/LAP-M, reducing the block size to 64 characters may give a smoother flow of data and better throughput on noisy phone lines. Using smaller block sizes over good phone lines may cause a slight loss in throughput (speed).
AT&BS0 = Maximum transmit block size of 64 characters
AT&BS1 = Maximum transmit block size of 128 characters
           (LAP-M) 256 characters (MNP)
The factory default setting is **&BS1**.

J.1.10   Speed Conversion Commands

Speed conversion is a necessary part of data compression since data must be presented to the modem faster than it can handle data, if data compression is to be effective.

Speed conversion allows the MMH2834 to communicate at one speed over the phone line, and at another speed at the RS232C interface. The speed (also referred to as *"data rate"* or *"baud rate"*) can be fixed at the RS232 interface independently of the baud rate of the on-line transmissions.

In addition to data compression, another popular application for speed conversion involves an auto-answer MMH2834 connected to a computer that does not have autobaud capability. This means that the computer must be set at a fixed baud rate, regardless of whether the modem is communicating over the phone line at 300, 1200, 2400, 9600, 14,400,19,200, 24,000 or 28,800 bps. In this application, speed conversion allows the modem to match its speed to that of the calling modem, while at the same time communicating with the attached computer through its RS232C port at a fixed baud rate, which can be preselected at 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600 or 115,200 bps.

Speed Conversion

$BA

When using speed conversion, you must set the modem so that it does not adjust its speed at the RS232C serial port, even if the modem does adjust its data rate. To turn Speed Conversion ON, enter the command ***AT$BA0***.

To turn Speed Conversion OFF, enter ***AT$BA1*** and hit RETURN. The modem will now match its RS232C speed to that of the computer, and will adjust its speed to any changes in the computer's speed in Originate mode, or to the speed of the originating modem in Answer mode. The speed at which the modem communicates over the phone line will always be the same as the speed at which it communicates via its RS232C serial port.

Modem Baud Rate   The **$MB** command presets the MMH2834's *transmission*
                          baud rate for originate operations, (i.e., the speed of the modem's
     $MB   transmissions over the telephone lines when originating a call).
                          With speed conversion, this transmission speed can be a different
                          baud rate than the serial port speed.

When the MMH2834 receives (answers) a call from another modem, it automatically switches its phone line transmission speed to match the calling modem. However, if the MMH2834 originates a call to another modem that is unable to connect at the baud rate of the MMH2834, it automatically drops to a lower baud rate in an attempt to match the speed of that modem. For example, if the MMH2834 is set for 19,200 baud and calls another modem that has a top speed of 2400 baud, it drops to 2400 baud.

The command to set the Modem Baud Rate is **AT$MBn**, where n can be 75 (in ITU-TSS V.23 mode) 300, 1200, 2400, 4800, 9600, 14,400,19,200 or 28,800 as listed below:

AT$MB75	=	CCITT V.23
AT$MB300	=	300 bps
AT$MB1200	=	1200 bps
AT$MB2400	=	2400 bps
AT$MB4800	=	4800 bps
AT$MB9600	=	9600 bps
AT$MB14400	=	14400 bps
AT$MB19200	=	19200 bps
AT$MB24000	=	24000 bps
AT$MB28800	***=***	***28800 bps***

The factory default is 28800 bps.

Serial Port Baud Rate	The **$SB** command presets the speed of the MMH2834's serial (RS232C) port, in both Originate and Answer modes. Speed conversion allows you to set this serial port baud rate at a fixed speed of up to 115,200 bps, regardless of the modem's transmission speed setting.
$SB	

In order for this command to be effective, the modem's Speed Conversion feature must first be turned off with the **$BA** command. When Baud Adjust is on, the MMH2834 automatically adjusts its serial port baud rate to match the speed of the computer or terminal it is connected to, as soon as it receives its first AT command. However, in many applications, such as automatic answer, the modem may not receive AT commands, in which case it is very useful to be able to preset the serial port baud rate with this **$SB** command.

In addition to setting the MMH2834's serial port speed, this command also sets the speed at which the modem issues Command mode responses.

The MMH2834 will accept AT commands at any speed, regardless of the speed preset by the **$SB** command. If the modem receives such a command at a speed that is different than the preset speed, the modem switches its serial port baud rate to match the new AT command speed, although the baud rate value stored by the **$SB** command remains the same. This provides you with a convenient way to switch the serial port speed, and still make it easy to go back to the original speed automatically the next time the modem is powered up or reset with an ***ATZ*** command.

The command to set the Serial Port Baud Rate is ***AT$SBn***, where n can be 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600 or 115200 bps as listed below:

AT$SB300	=	300 bps
AT$SB1200	=	1200 bps
AT$SB2400	=	2400 bps
AT$SB4800	=	4800 bps
AT$SB9600	=	9600 bps
AT$SB19200	=	19,200 bps
AT$SB38400	=	38,400 bps
AT$SB57600	=	57,600 bps
AT$SB115200	***=***	***115,200 bps***

The factory default is 115,200 bps.

*Some serial ports, particularly those in older PC-compatible computers, may limit the performance of a higher speed modem like the MMH2834. The limiting factor is a circuit called a Universal Asynchronous Receiver/Transmitter, or UART. All data from your modem flows through it. 8250, 16450, and 16550 are UARTs typically used in PC-compatible computers. The 8250 is unreliable above 9,600 bps and the 16450 is unreliable above 19,200 bps. The 16550 UART, however, is reliable to at least 115,200 bps. With V.42bis data compression enabled, the MMH2834 can achieve throughputs approaching 115.2K (depending on line quality and file content). If you presently do not have a 16550 UART in your PC, we recommend that it be replaced with a Multi-Tech high speed Intelligent Serial Interface (ISI) card. It comes in one, two and eight-port versions for DOS/Windows and UNIX systems, and includes a 32 K buffer that eliminates data loss even at high speeds. See your dealer for details.

J.1.11   Immediate Action Commands

Help Screens
$H

The Help command is designed to give you short explanations on how to use each MMH2834 command. The Help command can be quite useful if your manual is not handy and you are in the middle of a communications session. Although the explanations are quite abbreviated compared to those in this manual, they should prove to be helpful reminders when needed.

At the time of this writing, we have three screens of Help information (Screen #1, #2 and #3), and more screens may be added in the future. The Help commands are structured so that you can call up one of three Help screens, as follows:

AT$H1 = Help Screen #1
AT$H2 = Help Screen #2
AT$H3 = Help Screen #3

Inquiry for
Product Code
I

Some systems or software packages automatically check the *"identification"* of the modem with which they are communicating, by using the **I** command**.** This *"read"* command lets the software to determine the type of modem with which it is communicating. When *ATI* or *ATI0* is entered, the MMH2834 responds with *247*. When **ATI1** is entered, the modem responds with a three-digit code indicating the firmware version number. When **ATI2** is entered, the modem responds with *MMH2834*.

Listing Current
Operating
Parameters
L5

The *L5* and *L7* commands list the current operating parameters of your modem. This information can be very useful when you are changing communications software or when you are changing modem default settings.

The command to list the MMH2834's current operating parameters is *ATL5* for the basic parameters. The **ATL7**

L7

 command will list additional parameters on the MMH2834.

Listing S-Register
Values
L6

The *L6* command lists the current values stored in the modem's S-Register. This information can be very useful if you wish to change S-Register values. (Refer to Appendix G for more information on S-Registers).

Listing On-Line Diagnostics	The **L8** command displays the current on-line *CONNECT* status status of the MMH2834. This display can be printed and used as a modem status report or as diagnostic information (such as when calling Tech Support).This report is given only when on-line. To activate this command first type **+++AT<CR>**(*on-line escape command while maintaining command mode*), then type **ATL8**. What then displays on your monitor is your modem's current on-line condition (e.g., Link Type, Line Speed, Serial Speed, Type of Error Correction/Data Compression, Number of past Retrains,etc.).
L8	

An example of **L8** listing is shown below:

ATL8
```
******    ONLINE DIAGNOSTICS         ******
LINK TYPE                       V.34
LINE SPEED                      28800
SERIAL SPEED                    115200
ERROR CNTRL/COMPRESS            LAPM COMPRESSED
FALL BACK/FORWARD               LOCALLY ENABLED
LINE TYPE                       DIAL UP
DATA FORMAT                     ASYNCHRONOUS
LINE QUALITY                    0010=EXCELLENT,
                                8=FAIR, 16=BAD
RECV. SIGNAL LEVEL              -016.5  dBM
TRANS SIGNAL LEVEL              -013 dBM
NUMBER OF RETRAINS              000
ROUND TRIP DELAY                00ms  (MEANINGFUL
                                IN V32 MODE ONLY)
```

MultiMux

Glossary

MultiTech®
Systems

A

AC (Alternating Current): A power source whose signal crosses a reference voltage (usually called ground or zero). Alternating between a maximum and minimum voltage, AC may also be referred to as a bipolar signal. Contrast with DC.

ACK (ACKnowledgement code) (pronounced "ack"): A communications code sent from a receiving modem to a transmitting modem to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data. Contrast with NAK.

Address: A numbered location inside a computer. It's how the computer accesses its resources, like a video card, serial ports, memory, etc.

Alphanumeric: The basic character set which includes the letters A to Z (and a to z) and the digits 0 to 9.

Amplitude: The difference between the maximum and minimum voltages of a waveform expressed as a "peak-to-peak" voltage.

Amplifier: An active device within a circuit which increases the voltage level of all signals (desirable and undesirable).

Analog loopback: A modem diagnostic used to test either the local analog loop (the modem's internal circuitry) or the remote analog loop (the telephone line). The local analog loop test is accomplished by activating the self-test mode and tying the modem's modulator to its demodulator and examining the return stream of data at the PC or terminal it services. The remote analog loopback can only be activated on four-wire leased line connections with a remote modem capable of performing the same test.

Analog signal: A waveform which has amplitude, frequency and phase, and which takes on a range of values between its maximum and minimum points. Analog implies continuous movement from point A to point B, as opposed to discrete jumps. For example, sound is continuously varying air vibrations and is converted into analogous electrical signals to be carried on a telephone line.

Analog Transmission: One of two types of telecommunications which uses an analog signal as a carrier of voice, data, video, etc. An analog signal becomes a carrier when it is modulated by altering its phase, amplitude and frequency to correspond with the source signal. Compare with digital transmission.

ANSI (American National Standards Institute) (pronounced "ansy"): A U.S. standards organization supported by over 1000 companies and trade organizations. It is a non-profit, non-government group that is the U.S. member of the ISO (International Standards Organization).

ANSI character set: An 8-bit character set that contains 256 characters. The first 128 characters are alphanumeric punctuation and the second 128 contain math and foreign language symbols.

ASCII (American Standard Code for Information Interchange) (pronounced "askey"): A binary code for data that is used in communications and in many computers and terminals. The code is used to represent numbers, letters, punctuation and control characters. The basic ASCII code is a 7-bit character set which defines 128 possible characters. The extended ASCII file provides 255 characters.

Asynchronous Transmission: The transmission of data in which each character is a self-contained unit with its own start and stop bits. This is a common method of transmission between a computer and a modem. One character at a time, encoded into a series of electrical pulses, is transmitted or received. This the oldest method of data transfer. When it is used with error correcting software and data compression algorithms, along with the increase in maximum attainable speeds, it continues to be a viable alternative to synchronous transmission..

Auto Answer: A modem feature which enables the modem to go "off-hook" when it detects an incoming call.

Auto Dial: Some modems provide this feature for asynchronous dialing. This feature is a predefined macro that allows the user to enter the location of a phone number (i.e., N0 through N9) and have the modem go off hook, dial and establish the connection. With the auto dial feature, an asynchronous terminal can establish a dialing directory without running a communication software package.

B

Baud: Baud is rate, the signalling rate of a line, the switching speed, or the number of transitions (voltage or frequency changes) that are made per second. Transmission speeds are often expressed in baud, though bits per second is more accurate. The speed at which your computer talks to your modem.

BCC (Block Check Character): An error control method used in character-oriented or byte-synchronous protocols. Two 8-bit BCC's are used to create the CRC (Cyclic Redundancy Check) field of a synchronous data packet.

Bell 103: The U.S. modulation standard for 300 bps full-duplex transmission over dial-up lines.

Bell 212A: The U.S. modulation standard for 1200 bps full-duplex transmission over dial-up lines.

Binary: A numbering system based on two digits, 1 and 0 which is conducive to the two-state digital electronics used within computers. All input to a computer is encoded as a binary value. Binary also refers to a file format that uses 8-bit characters, to allow for control characters (i.e., all non-ASCII files).

BSC (Binary Synchronous Communications): Also called "bisync", this communications protocol was the first synchronous data format used by IBM. It is still in use, but is rapidly being replaced by IBM's newer Synchronous Data Link Control (SDLC). Bisync is a byte-synchronous protocol that has longer delays and more overhead than the bit-synchronous SDLC. It uses two synchronization characters to head every packet.

Bit (Binary digIT): A bit is the basis of the binary number system. It can take the value of 1 or 0. Bits are generally recognized as the electrical charge generated or stored by a computer that represent some portion of usable information.

Bit-synchronous transmission: A synchronous form of data transmission that focuses on a maximum packet size rather than the length of the characters the packet contains. SDLC is a bit-synchronous protocol.

Boot: To start or restart your PC. This term originates from the saying " to pull oneself up by the bootstraps".

Bps (bits per second): A unit to measure the speed at which data bits can be transmitted or received. Bps differs from baud when more than one bit is represented by a single cycle of the carrier.

Buffer: A temporary storage register or Random Access Memory (RAM) used in all aspects of data communications which prevents data from being lost due to differences in transmission speed. Keyboards, serial ports, muxes and printers are a few examples of the devices that contain buffers. A buffer allows one device to dump data at a high speed and for the lower-speed device to accept it at its own pace. In this way , the high-speed device can continue its work without having to wait for its data transfer to end. Buffers are a way of preventing potential data loss.

Bus: A common channel between hardware devices either internally between components in a computer, or externally between stations in a communications network.

Byte: The unit of information a computer can handle at one time. The most common understanding is that a byte consists of 8 binary digits (bits), because that's what computers (PCS) can handle. A byte holds the equivalent of a single character (such as the letter A).

C

Capacitor: An electronic device that stores an electrical charge. It comes in varying sizes for use in anything from power supplies to the tiny cells in dynamic RAM chips. When the device is powered down, it's capacitors lose their charge.

Carrier signal: An analog signal with known frequency, amplitude and phase characteristics used as a transport facility for useful information. By knowing the original characteristics, a receiver can interpret any changes as modulations, and thereby recover the information.

CCITT (Consultative Committee for International Telephone and Telegraph): An advisory committee created and controlled by the United Nations and headquartered in Geneva whose purpose is to develop and to publish recommendations for worldwide standardization of telecommunications devices. CCITT has developed modem standards that are adapted primarily by PTT (post, telephone and telegraph) organizations that operate telephone networks of countries outside of the U.S..

Character set: One of a number of coding schemes which uses binary digits to represent characters, numbers, punctuation, and/or control characters. Common character sets are ASCII, ANSI or EBCDIC.

Checksum: A control field found in synchronous data packets which contain the results of the error control algorithm used.

Chip: Also called integrated circuits (IC), they are squares or rectangles that contain from a few dozen to a few million electronic components.

Circuit: Any closed path through which electrical current can flow.

Circuit-switched Network: A technology used by the PSTN that allocates a pair of conductors for the exclusive use of one communication path. Circuit switching allows multiple conversations on one talk path only if the end-users multiplex the signals prior to transmission.

Circuit switching: The temporary connection of two or more communications channels using a fixed, non-shareable path through the network. Users have full use of the circuit until the connection is terminated.

Clock: A timing signal generated by an oscillating circuit which is used to synchronize data transmissions.

Command: An instruction that tells a computer to begin, continue or end a specific operation.

Command mode: One of two states of an intelligent (i.e. programmable) device. The mode in which commands can be issued to alter operating parameters.

CRC (Cyclic Redundancy Check): A field used in packetized data that contains two 8-bit BCCs (Block Check Characters) as the binary result of an algorithm performed on the data bits in the packet. A CRC is used for error detection by many synchronous protocols.

CTS (Clear To Send signal): With communications between modems, an RS-232 signal sent from the modem to the DTE that indicates it is ready to accept data. Contrast with RTS.

D

DC (Direct Current): This is usually understood to mean a constant voltage supply that fluctuates only a nominal amount. An analog or digital signal that may vary in voltage level, but it never crosses the reference voltage (usually called ground). Contrast with AC.

De facto standards: A de facto standard is one of two types of voluntary standards recognized by a given market. It is introduced by a single vendor and becomes a standard by its widespread use and acceptance by other vendors. AT&T's Bell 212A, IBM's Binary Synchronous Protocol or DEC's VT-100 terminal protocol are examples of de facto standards. Compare with de jure standards.

De jure standards: A de jure standard is one of two types of voluntary standards. It represents the collective consensus of the industry and users for a particular aspect of manufacturing. CCITT's V and X standards (e.g. V.32 and X.25) are examples of de jure standards. Compare with de facto standards.

Decibel (dB): A unit of measurement for signal strength based on logarithmic increments. A decibel is a relative measurement that is derived from an initial reference level and a final observed level.

Default: This is preset value or option in software packages, or in hardware configuration, that is used unless you specify otherwise.

Device driver: Software that controls how a computer communicates with a device, such as a printer or mouse.

Digital signal: Digital devices, such as terminals and computers, transmit data as a series of electrical pulses which have discrete jumps rather than gradual changes.

Digital Transmission: A method of electronic information transmission common between computers and other digital devices. Analog signals are waveforms: a combination of many possible voltages. A computer's digital signal may be only "high" or "low" at any given time. Therefore, digital signals may be "cleaned up" (noise and distortion removed) and amplified during transmission.

DIP switch (pronounced "dip switch"): A set of tiny toggle switches, built into a DIP (dual in-line package), used for setting configurable parameters on a PCB (printed circuit board).

DPSK (Differential Phase Shift Keying): A common form of phase modulation used in modems. It does not require complex demodulation circuitry and is not susceptible to random phase changes in the transmitted waveform, thus reducing errors during transmission.

DSR (Data Set Ready): An RS232 signal sent from the modem to the computer or terminal indicating that it is able to accept data. Contrast with DTR.

DTE (Data Terminating Equipment): A term used to include any device in a network which generates, stores or displays user information. DTE is a telecommunications term which usually refers to PCs, terminals, printers, etc.

DTMF (Dual-Tone MultiFrequency): A generic push-button concept made popular by AT&T TouchTone.

DTR (Data Terminal Ready): An RS232 signal sent from the computer or terminal to the modem indicating that it is able to accept data.

E

EBCDIC (Extended Binary Coded Decimal Interexchange Code) (pronounced "eb suh dick"): An IBM character code used in its mainframe and midrange computers. It is an 8-bit code (256 combinations) that stores one alphanumeric character or two decimal digits within a byte. This code and ASCII are the most commonly used to represent data.

Echo: The reflection or duplication of a signal back toward its source. Echoing is useful when a terminal is transmitting data, in that the data can be echoed to the screen so the user can monitor what is being sent. Echoing is undesirable when it refers to the signal which results on a telephone line from impedance mismatches.

Echo cancellation: A high speed modem technique that isolates and filters out unwanted signals caused by echoes from the main transmitted signal. This allows full-duplex modems to send and receive on the same frequency carrier.

EIA (Electronics Industries Association): A membership organization founded in 1924 that includes manufacturers of electronic parts and systems. With over 1200 members, it sponsors shows and seminars and gives awards for outstanding contributions in electronics. It sets electronic interface standards, such as RS-232.

Environment: A computer configuration that includes the CPU model and system software (operating system, data communications and database systems). It may also include the programming language used. It sets the standards for the applications that run in it.

EPROM (Erasable Programmable Read Only Memory) (pronounced "eeprom"): A reusable PROM chip that holds its contents until erased under ultraviolet light.

Error correction: The process of detecting distorted data bits and requesting a retransmission or interpretation to correct the error. Errors are introduced by bad line conditions or external interface.

F

Fax (facsimile): Refers to the bit-mapped rendition of a graphics-oriented document (fax) or to the electronic transmission of the image over telephone lines (faxing). Fax transmission differs from data transmission in that the former is a bit-mapped approximation of a graphical document and, therefore, cannot be accurately interpreted according to any character code.

Firmware: A category of memory chips that hold their content without electrical power, they include ROM, PROM, EPROM and EEPROM technologies. Firmware becomes "hard software" when holding program code.

Flash Memory: A memory chip that holds its content without power, but must be erased in bulk. The term comes from its ability to be erased "in a flash". Flash memory is derived from EEPROM, but are less expensive and provide higher bit densities.

Flow control: The process of regulating the speed at which data enters or leaves a serial port. Software flow control is implemented by communications software or by the user sending predefined characters or packets which are recognized as "pause" and "resume" indicators. Hardware flow control is achieved by using the RTS (request to send) and the CTS (clear to send) control lines of the RS232 interface.

Footprint: The desk or floor surface that a piece of hardware occupies. Also referred to as "real estate".

Foreground: The application program currently running on and in control of the PC screen and keyboard. The area of the screen that occupies the active window. Compare with background.

Format:

1. The way text is set up on a page.

2. To prepare a disk for holding information. Formatting a disk can delete all information that was previously on it.

3. The way information is structured in a file, often specific to one application or protocol.

Frequency: A characteristic of an electrical or electronic signal which describes the periodic recurrence of cycles. Frequency is inversely proportional to the wavelength or pulse width of the signal (i.e., long wavelength signals have low frequencies and short wavelength signals yield high frequencies).

Full-duplex: A method of transmitting and receiving data simultaneously over a single pair of wires. Compare with Half-Duplex.

G

H

Half-Duplex: The transmission of data in both directions, but only one direction at a time. Compare with Full-Duplex.

Handshaking: A process that two modems go through at the time of call setup to establish synchronization over the data communications link. It is a synchronization and negotiation process accomplished by the exchange of predefined, mutually recognized control codes.

Hard Disk: A metal disk covered with magnetic recording material. Some can hold up to several hundred megabytes of information. Contrast with floppy disk.

Hardware: The equipment that makes up your computer system, including the keyboard, mouse, disk drives and monitor.

Hexadecimal: A base 16 numbering system used to represent binary values. Hex uses the numbers 0-9 and the letters A-F: usually notated by an "h" (e.g., "4CF h", read "four charley fox, hex"). The result is that one hex digit represents a 4-bit value.

Host: The computer that is designated as retaining information or processing power to service the needs of other computers or terminals. Mainframes and mid-range computers are hosts; however, with today's powerful microprocessors, PCs can also be configured to serve as hosts. Often, a PC on a LAN will be set up as a host to provide LAN access for remote users.

I

Initialize: To start anew and establish start-up parameters, typically involves clearing all or some part of the device's memory or disk space.

Interface: A common meeting ground supplied by hardware or software to facilitate a compatible connection and operation between two devices or programs. For example, when two PCs are connected, they use a common interface across the physical connectors, so that the signals being sent and received are accurately interpreted. With software, an interface is a module created to be "written to". That is, if two programs are written to the same interface, then they can be successfully linked together.

IRQ Level (Interrupt Request Level): The notification a processor receives when another portion of the computer's hardware requires its attention. IRQs are numbered so that the device issuing the IRQ can be identified, and so IRQs can be prioritized.

J

K

Kilobit: One thousand bits. A unit of measure for digital data rates.

Kilobyte: One thousand bytes. A unit of measure for digital data rates. Not to be confused with "K", which stands for z^{10} bytes of storage space, either in memory or on disk. 1K of disk space is actually 1024 bytes, 16K is 65,536 bytes and 1M (meg) is 1,048,576 bytes.

L

Leased Line: A private, dedicated communications channel that connects two locations. This connection lasts for the duration of the subscription. Leased lines may be conditioned to improve line quality over that of dial-up lines.

Line Conditioning: An additional cost option offered by the telephone company for their leased, voice-grade lines. The service provides a careful balance of line enhancements to improve the frequency response and to reduce distortion.

LRC (Longitudinal Redundancy Check): Error checking method that generates a parity bit from a specified string of bits on a longitudinal track. In a row and column format such as on magnetic tape, LRC is often used with VRC, which creates a parity bit for each character.

M

Mainframe: A large, powerful computer used to centralize a data processing environment. It has hundreds of gigabytes of disk storage space. It uses a front end processor to connect directly to the communications channels that interconnect terminals and computers.

Megabyte: One million bytes when describing a data rate. 1M of disk space may actually mean 1,048,576 bytes.

Mid-range computer: A term coined by IBM referring to any of their Advanced Business Systems computers. This product line was originally called their mini-computers, but as the number of supported users approached mainframe capabilities, the term "mid-range" caught on.

Mnemonics: A term assigned to a complex idea, value, or list of information which is found to be representative of that information. Computer commands are almost entirely mnemonics. Mnemonics are used as memory aids for people.

Modem: A communications device that enables a computer to transmit information over a telephone line. It converts the computer's digital signals into analog signals to send over a telephone line and converts them back to digital signals at the receiving end. Modems can be internal and fit into an expansion slot, or external and connect to a serial port.

Modulation: The process of encoding information from one signal (called the source) into another (called the carrier) by modifying some characteristic(s) of the carrier. It is often used in telecommunications when one type of signal must be converted for transmission over an otherwise incompatible medium.

Multiplexer (mux): A device that merges several signals into one composite signal for transmission over a single medium or channel. A de-multiplexer (usually built into a mux) reverses the process at the receiving end.

N

NAK (Negative Acknowledgment): Communications code used to indicate that a message was not properly received, or that a terminal does not wish to transmit. Contrast with ACK.

Network: A group of computers connected by cables or other means and using software that enables them to share equipment, such as printers and disk drives to exchange information.

Node: Any point within a network which has been assigned an address.

Normal mode: In modem operation, refers to a mode of operation without error correction active.

O

Off-hook: The condition of a device which has accessed a phone line (with or without using the line). In modem use, this is equivalent to a telephone handset being picked up. Dialing and transmission are allowed, but incoming calls are not answered.

On-Hook: The condition of a device which has not accessed a phone line. In modem use, this is equivalent to a telephone handset that has not been picked up. In other words, it can receive an incoming call.

P

Parameter:

1. A "place holder" in a command which should be substituted with useful information.

2. The list of acceptable values for a given option or command. In UNIX, the generic command should be typed in as Stty/s 9600. Where "Stty" is the command, "s" is the speed switch, and "9600" where s=1200-115,200 bps.

Parity bit: An extra bit attached to each byte of synchronous data used to detect errors in transmission.

PCB (Printed Circuit Board): A flat board that holds chips and other electronic components. The board is "printed" with electrically conductive pathways between components. The main PCB in a system is called a motherboard and the smaller PCBs that plug into the slots in the motherboard are called daughter boards or cards.

PCMCIA (personal computer memory card international association): An organization of U.S. and Japanese companies set up to standardize memory cards and other architecture-independent expansion devices. These cards are typically used in laptop computers.

Phase: The timing of a signal based upon the starting point of each cycle in another signal. To be detected phase requires the comparing of two signals. If the cycle of two signals begin at the same point, they are said to be "in-phase". In-phase signals add, while out-of-phase signals tend to cancel each other.

Port: A location for input or output data exchange. Computers, muxes, etc. have ports for various purposes.

Program: A collection of computer instructions that tell the computer what to do.

PROM (Programmable Read Only Memory): (pronounced "prom") A permanent memory chip that can be programmed or filled by the customer after by the manufacturer has set initial values. Contrast with ROM.

Prompt: A request for information from the PC that provides required input or information.

Protocol: A set of rules that defines how computing devices communicate with each other. The rules governing the transmitting and receiving of data.

PSTN (Public Switched Telephone Network): A worldwide public voice telephone network that is used as a telecommunications medium for the transmission of voice, data and other information.

Pulse dialing: One of two methods of dialing a telephone, usually associated with rotary-dial phones. Compare with tone dialing.

Pulse-width: This pertains to a digital signal. Pulse width refers to the duration of one state between clocking signals. Pulse width roughly corresponds to an analog signal's wavelength.

Q

Queue: A set of activities that are waiting in chronological order for an action, such as printing, to be performed.

R

Rack: A frame or cabinet into which components are mounted. The industry standard rack is 19" wide and has variable depth and height.

Rackmount: A packaging style available for many types of electronic equipment which enables the installer to mount the equipment in an industry standardized enclosure. The rackmount equipment is fitted with brackets, rather than being packaged in its own enclosure. Rackmounting conserves disk or floor space (real estate) and often conserves power outlets.

RAM (Random Access Memory) (pronounced "ram"): A computer's primary workspace. All data must be stored in RAM (even for a short while), before software can use the processor to manipulate the data. Before a PC can do anything useful it must move programs from disk to RAM. When you turn it off, all information in RAM is lost.

RJ-11: An industry standard interface used for connecting a telephone to a modular wall outlet; comes in 4-and 6-wire packages.

RJ-45: An 8-wire modular connector for voice and data circuits.

ROM (Read Only Memory) (pronounced "rom"): A memory chip that permanently stores instructions and data. Its contents are created at the time it is manufactured and cannot be altered. ROM is used to store control routines in PCs and peripheral controllers. ROM is also used in the plug-in cartridges for printers and video games. A set of ROM chips contain the basic input/output system (BIOS).

RS232-C: An EIA standard for a serial interface between computers and peripheral devices (modem, mouse, etc.). It uses a 25-pin DB-25, or a 9-pin DB-9 connector. The RS-232 standard defines the purposes, electrical characteristics and timing of the signals for each of the 25 lines.

RTS (Request To Send signal): With communications between modems, an RS232 signal sent from the DTE to the modem requesting permission to transmit. Contrast with CTS.

S

Serial Port: The connector on a PC used to attach serial devices (those that need to receive data one bit after another), such as a mouse, a printer or a modem. This consists of a 9- or 25-pin connector that sends data in sequence (bit by bit). Serial ports are referred to as "COMx" ports, where x is 1 to 4 (i.e., COM1 through COM4). A serial port contains a conversion chip called a "UART" which translates between internal parallel and external serial formats.

Switched Line: In communications, a physical channel established by dynamically connecting one or more discreet segments. This connection lasts for the duration of the call after which each segment may be used as part of a different channel. Contrast with leased line.

Switched Network: A network in which a temporary connection is established from one point via one or more segments.

Synchronous Transmission: The transmission of data which involves sending a group of characters in a packet. This is a common method of transmission between computers on a network or between modems. One or more synchronous characters are transmitted to confirm clocking before each packet of data is transmitted. Compare to Asynchronous Transmission.

T

T1 Transmission: A standard transmission speed of 1.544M bps that may be used in its full bandwidth, or as narrower channels called "fractional T1" carriers.

Terminal: The screen and keyboard device used in a centralized computing environment for interactive data entry. Terminals have no "box", which is to say they have no file storage or processing capabilities.

Terminal emulation: This allows a PC to access a mainframe computer by generating and accepting data like a "dumb" terminal.

Threshold: A value or condition which, when reached, triggers an event.

Toggle: To alternate back and forth between two states.

Tone dialing: One of two methods of dialing a telephone, usually associated with Touch-Tone® (push button) phones. Compare with pulse dialing.

Transistor: A semiconductor device used to amplify a signal, or open and close a circuit. In digital computers, it functions as an electronic switch.

Twisted pair wiring: A type of cabling with one or more pairs of insulated wires wrapped around each other. An inexpensive wiring method used for LAN and telephone applications, also called UTP wiring.

U

UART (Universal Asynchronous Receiver/ Transmitter) (pronounced "you art"): A chip that transmits and receives data on the serial port. It converts bytes into serial bits for transmission, and vice versa, and generates and strips the start and stop bits appended to each character.

UTP (unshielded twisted pair): Telephone-type wiring.

V

V.21: The CCITT modulation standard for 300 bps, full-duplex transmission over dial-up lines.

V.22: The CCITT modulation standard for 1200 bps, full-duplex transmission over a dial-up or 2-wire leased line. This is not common in North America.

V.22bis: The CCITT modulation standard for 2400 bps, full-duplex transmission over a dial-up or 2-wire leased line.

V.23: The CCITT modulation standard for 75/ 1200 bps, half-duplex transmission over dial-up lines. This is not common in North America.

V.24: The CCITT hardware interface specification for interchange circuits between the DTE and DCE.

V.35: The CCITT hardware interface specification commonly used by DSU/CSUs and other high-speed devices.

W

WATS (Wide Area Telephone Service) (pronounced "watts"): A discounted long-distance calling plan that allows calls in or out. The popular 800 numbers are WATS lines in. The calls are charged to the holder of the 800 number at a discounted rate.

Workstation: Traditionally a workstation has been a dumb terminal connected to a host. With the advent of LANs and WANs, PCs that are connected to a LAN are now called workstations also, even though they are capable of independent processing. A workstation, then, is simply an input/display device through which a user accesses a resource.

X

Y

Z

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